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23rd Annual Session
AMERICAN CONGRESS OF PHYSICAL THERAPY

September 6, 7, 8, 9, 1944

HOTEL STATLER CLEVELAND, OHIO

Volume XXV MAY, 1944 No. 5

AMERICAN CONGRESS OF PHYSICAL THERAPY

23rd ANNUAL SCIENTIFIC and CLINICAL SESSION

September
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EDITOR OF MONTH

RICHARD KOVACS, M.D.

New York, N. Y.

Printed in U. S. A.

MEETINGS OF PHYSICAL THERAPY ORGANIZATIONS

In these columns will be published information about meetings of physical therapy organizations. New data should be sent promptly to the office of the Secretary, 2 E. 88th St., New York 28, N. Y.

American Congress of Physical Therapy, 23rd Annual Session, Hotel Statler, Cleveland, September 6, 7, 8, 9, 1944; **Instruction Course** to be held during the meeting; Dr. Richard Kovács, 2 East 88th Street, New York 28, Secretary. See announcement elsewhere this issue.

Midwestern Section, American Congress of Physical Therapy, Detroit, Michigan, Wednesday, May 31st, 1944. Dr. M. K. Newman, 10 Peterboro St., Detroit, Michigan, Chairman. See announcement elsewhere this issue.

New York Physical Therapy Society; meetings on first Wednesdays, from October to May, New York City; Dr. Madge C. L. McGuinness, 1211 Madison Avenue, New York 28, Secretary.

Kings County Medical Society, Physical Therapy Section; meetings at 1313 Bedford Avenue, Brooklyn, bi-monthly on second Thursdays; Dr. Samuel A. Warshaw, 1373 Ocean Parkway, Brooklyn, N. Y., Secretary.

New England Society of Physical Medicine, meetings at Hotel Kenmore, Boston, on third Wednesday from October to June; Dr. William McFee, 41 Bay State Road, Boston 15, Mass.

The Penna. Academy of Physical Medicine; meeting at the Phila. County Medical Building, 21st and Spruce Streets, third Thursday, alternate months; Dr. Harold Lefkoe, 1824 Spruce Street, Philadelphia 3, Secretary-Treasurer.

American Physiotherapy Association, 22nd Annual Conference, Hotel Pennsylvania, New York City, May 17 to 21, 1944. Evelyn Anderson, 5 Rico Way, San Francisco, Calif., Secretary.

National Council on Rehabilitation, annual meeting Carlton Suite, Ritz-Carlton Hotel, Madison Avenue and 45th Street, New York City, 9:30 A.M. to 4:30 P. M., June 5 and 6, 1944. Secretary, Holland Hudson, 1790 Broadway. New York 19, N. Y.

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INFLUENCE OF SHORT WAVE CURRENT ON INTRASPINAL TEMPERATURE

WILLIAM BIERMAN, M.D.

Attending Physical Therapy Physician, Mount Sinai Hospital

and

SERGEI FEITELBERG, M.D.

Physicist, Mount Sinai Hospital

NEW YORK

The use of the short wave current in the effort to influence human disease receives objective justification in the fact that it is possible to cause a substantial elevation of temperature within tissues at a considerable distance beneath the skin in the living human subject.*

We were interested in determining whether there is any objective warrant for the therapeutic application of the short wave current to the region of the human spine. We accordingly investigated the temperature changes produced within the spinal canal of the living human subject by the localized application of the short wave field.

Technic

Short Wave Current. — With the patient in the prone position, two rectangular electrodes, 6 by 8 inches, were placed on his back in coplanar fashion, equally distant and above and below the site of the lumbar puncture. The distance between the electrodes varied from 5 to 5½ inches; the spacing from the skin was about 2 inches. The short wave current was applied for twenty minutes to the point of comfortable tolerance. The short wave generator employed produced a current of 50 megacycles.

Thermal Measurement. — An iron-constantan thermocouple was built into a steel tube of 0.034 inch outside diameter. The iron wire used was B. & S. 30 gage and the constantan 40 gage. The tube was 4 inches long and fitted into a spinal puncture needle. A tapered brass plug was soldered to the tube in such a way that the spinal puncture needle was sealed when the steel tube, with the plug on one end, was inserted. The tip of the tube, where the thermocouple junction was located, protruded about 0.05 inches beyond the orifice of the spinal tap needle.

The second thermocouple junction was attached to a thermometer bulb and was placed in a thermos flask filled with water at 99 to 100 F. The connection to the copper leads from the galvanometer and the Ayrton shunt were also located within the thermos flask (above the water level), in order to eliminate parasitic electromotive force.

A multireflection box type galvanometer was used, with the sensitivity of 1 microvolt per division when critically damped.† The electromotive force of an iron-constantan thermocouple is 52 microvolts per centigrade degree. A sensitivity of one division per 0.02 degree C. results, which is too high for our purpose, as the changes in temperature to be expected are in the order of several degrees Fahrenheit, and it is advisable to have a range of about 10 degrees F. on the galvanometer scale, which has one hundred divisions.

* For a detailed discussion and references see Bierman, William: The Medical Application of the Short Wave Current, Baltimore, Williams & Wilkins Company, 1942.

† General Electric type 32C240G1 : 0.021 microampere per division, inner resistance 13.5 Ohms, critical damping resistance 34 Ohms, period 3.6 seconds.

The sensitivity was therefore reduced by an Ayrton shunt, and an empiric calibration done: The sensitivity was six and five-tenths scale divisions per Fahrenheit degree, which gives a range of about 8 degrees F. above and below zero (temperature of the reference junction).

A spinal puncture was done before and after application of the short wave current. The thermocouple was then inserted through the spinal tap needle, and the reading on the galvanometer, as well as the temperature of the reference junction in the thermos flask, was noted. The spinal puncture needle could not be left in place during the period of current flow because of the distortion of the electrical field and excessive heating of the metal. The interval between the switching off of the current and the taking of the reading was about two to three minutes. Oral and rectal temperatures were measured with clinical thermometers.

Results

Table 1 gives the results of our measurements.

TABLE 1. — *Temperature (F.) Before and After Application of Short Wave Current.*

Case	Patient	Sex	Age	Before			After			Increase		
				Oral	Rectal	Spinal	Oral	Rectal	Spinal	Oral	Rectal	Spinal
1	F. B.	M	42	.....	98.4	97.2	.....	99.8	99.5	....	1.4	2.3
2	K. K.	F	45	97.2	98.8	96.6	98.6	99.2	98.8	1.4	0.6	2.2
3	J. C.	M	56	99.0	99.6	98.7	99.4	100.2	101.1	0.4	0.6	2.4
4	J. L.	M	38	99.0	99.6	98.5	99.4	100.2	100.5	0.4	0.6	2.0
5	W. K.	M	48	99.2	99.6	99.1	99.4	101.0	101.7	0.2	1.6	2.6
6	H. T.	M	62	98.6	99.0	98.4	99.0	99.8	100.3	0.4	0.8	1.9
7	R. F.	F	65	97.8	98.2	97.7	98.4	99.8	101.5	0.6	1.6	3.8
8	E. K.	F	24	98.0	99.4	97.4	99.4	99.8	101.7	1.4	0.4	4.3
9	S. R.	F	48	98.2	98.4	98.0	99.2	101.0	101.5	1.0	2.6	3.5
10	I. H.	M	13	.....	99.0	98.8	.....	100.4	100.5	....	1.4	1.7
11	M. H.	M	20	98.6	98.6	98.1	99.0	99.4	100.0	0.4	0.8	1.9
	Mean Value			98.4	98.9	98.0	99.1	100.0	100.6	0.7	1.1	2.6
	Standard Deviation of the Mean									0.16	0.18	0.25

It will be noted that normally the temperature in the spinal canal is below the rectal temperature.

The increase in intraspinal temperature was greater than the increase in systemic temperature—indicating that a localized heating is achieved. With the technic we employed, the region of the rectum was contained within the high frequency field.

Table 2 summarizes the statistical analysis of our data.*

TABLE 2. — *Summary of Statistical Analysis.*

	Significance Ratio
Increase of spinal temperature	10.4
Increase of rectal temperature	6.1
Increase of oral temperature	4.5
Difference between increase of spinal and oral temperature	6.3
Difference between increase of spinal and rectal temperature	4.5
Difference between increase of oral and rectal temperature	1.6

In 2 patients the spinal puncture needle with the thermocouple *in situ* was left in position for twelve minutes after the current was switched off, so that we might see how long the increased temperature would be maintained. No fall of temperature was observed during this interval. This

* The conventional interpretation of the significance ratio assumes that observations with a ratio greater than 3 are significant.

would indicate that thermal dispersion within the spinal canal is not as rapid as it is in tissue with an active vascular circulation.

Summary

The intraspinal temperature was measured thermo-electrically before and after application of the short wave current to the region of the spine in 11 patients. It increased 2.6 F. on the average, while the oral and rectal temperature increased 0.7 F. and 1.1 F., respectively.

PHYSICAL THERAPY IN THE VETERANS ADMINISTRATION *

CHARLES M. GRIFFITH, M.D.

Medical Director, Veterans Administration

WASHINGTON, D. C.

Physical therapy has been used in Veterans Administration hospitals for over two decades as an aid to the medical rehabilitation of our patients. Coordinated with this branch of medicine are other adjunct physical measures used in the rehabilitation of ex-service men and women.

Physical therapy, occupational therapy, supervised exercise, recreational functions and library activities are each a part of a therapeutic program designed to assist in the reestablishment of the patient as an economic unit. It is considered that with this objective in mind an intensive program has therapeutic value, improves morale and provides encouragement for future activity. Such a program has been developed in the Veterans Administration hospitals, particularly in those maintained for the treatment of neuropsychiatric and tuberculous patients.

Each physical therapy department is headed by a physician. At the larger hospitals he is designated as a reconstruction officer. When so assigned, he is also detailed to supervise occupational therapy, prescribed exercise and planned recreation. The duties of the physician in charge of physical therapy consist of reviewing the prescriptions forwarded by the ward physicians and the chiefs of the specialistic medical services, evaluating the patients' disabilities and, if this is indicated, outlining additional treatment. To him is delegated the final decision with regard to the physical therapy to be administered, the supervision of such treatments from day to day, and the revision or discontinuance of the treatment according to the progress of the individual patient. The assignment of a physician in charge of one or more of these adjunct treatments carries with it specific requirements in regard to the medical supervision of each patient treated in the physical therapy department or participating in one of the other activities mentioned. The physical therapy clinical record becomes a permanent part of the patient's folder.

Although the physician in charge of physical therapy is responsible for the administration of treatment by the technicians and the proper functioning of the department, the patients are referred for physical therapy by the ward physician or the chief of a specialistic service. For this reason the

* Read at the Spring Session, Eastern Section, American Congress of Physical Therapy, Washington, D. C., April 18, 1944.

ward physicians must be able to determine the reason for physical therapy as well as to furnish the diagnosis. The ward physician is held responsible for prescribing all treatment for patients under his care, and no exception is made to physical therapy measures. He is expected to familiarize himself with physical therapy by studying current literature and by attendance at lectures to the staff on this subject by the physician in charge of the physical therapy. During the past year twenty-one Veterans Administration physicians have completed physical therapy wartime courses in preparation for the impetus to physical therapy which will result from the admission of casualties from World War II. Others will be assigned to attend these courses when they can be arranged.

At present there are fifty general medical, thirty neuropsychiatric and fourteen tuberculosis hospitals, and there are also two regional offices which have one or more physical therapy departments. Necessarily the pattern of physical therapy measures varies in each group to suit the needs of the specific type of patient hospitalized or cared for as an outpatient. In the general medical and surgical hospitals the preponderance of physical therapy, in recent years, has been for arthritic and peripheral vascular diseases or other conditions associated with the advancing age of the World War I veteran. The neuropsychiatric hospitals require extensive use of sedative baths and packs. In the tuberculosis facilities greater utilization is made of ultraviolet ray treatments and graduated exercises, although all types of treatment are administered for the concomitant conditions found with pulmonary tuberculosis.

In general, the physical therapy departments are on the ground floor and are easily accessible from the wards. They consist of a large general treatment room, and in the general medical and neuropsychiatric hospitals there is an adjoining hydrotherapy section. The tuberculosis and general medical facilities are supplied with solariums, both indoors and out, when these are required. A considerable amount of treatment is given on the wards, especially in tuberculosis hospitals, either at the bedside or in a room on the ward equipped for that purpose. In addition to the usual physical therapy department in the infirmary building of the neuropsychiatric hospitals, there is at least one smaller complete unit in the acute service building. On a ward of every acute service building or connected building there are continuous flow tub and pack rooms. The larger neuropsychiatric hospitals operate three to eight physical therapy sections, with twenty-four hour service in the tub and pack rooms for the disturbed patients. Electric shock therapy and artificial fever are employed as required.

In the hospitals recently constructed the main treatment room has windows on three sides with a dressing room conveniently located between it and the hydrotherapy section. On the opposite side of the corridor from the hydrotherapy space are the office, waiting room and linen closet. At some stations there is a separate exercise room, but at most facilities a part of the large general treatment room is used for this purpose. It has been found that a room which is almost square permits better supervision, and when, as at present, expansion is necessary such a room proves more adaptable to change. The hydrotherapy and pack rooms have forced draft ventilation.

The equipment furnished also varies with each type of hospital. All stations are generously supplied with the best equipment available in short wave diathermy units, low voltage generators, galvanic-faradic electrodiagnostic units, air-cooled and water-cooled quartz ultraviolet ray lamps, a carbon arc lamp, luminous and infra-red ray lamps and bakers. In the hydro-

therapy section there are a control table, shower bath, electric light cabinets and at least one arm and one leg whirlpool bath and two sitz baths. Most of the neuropsychiatric hospitals have gymnasiums and swimming pools. The mechanotherapy apparatus usually consists of stall bars, a shoulder wheel and a shoulder abduction ladder. Some stations have a rowing machine, exercycle, walker and other items. Additional exercise equipment is being secured to care for the younger patients now entering the hospitals. One of the solarium installations is a mercury quartz vapor lamp; the other lamps are carbon arc.

The spa at Saratoga Springs, N. Y., is maintained for those who may benefit from treatment with mineral baths and packs. There is also a complete hydrotherapy unit such as has been described. Exercise and massage are also extensively employed. The Bay Pines, Fla., hospital makes unique utilization of the nearby ocean water and beach for heliotherapy and exercise. Provision of a windbreak and a beach house permits this work to be carried on almost the year around. Arthritic patients particularly have benefited from these treatments.

There are two regional offices which have physical therapy departments, and in addition there are forty-two such offices combined with hospitals. In the nine stations which have domiciliary barracks, the home members are treated as outpatients. Approximately 12 per cent of the total number of patients treated with physical therapy are outpatients. It is anticipated that there will be a marked increase in the physical therapy administered to outpatients who are able to continue work and report to the department for treatment. The Bronx hospital in New York City is now operating for three hours one evening a week in addition to the usual eight hours daily, in order to care for outpatients who need treatment but do not require hospitalization.

A complete record of treatment is maintained for each patient, not only as a matter of record, but in order that results may be evaluated. The fact that the patients are available for the prescribed treatment without financial consideration being involved permits the application of heat several times a day when this may be beneficial. For the same reason it is possible to institute an intensive program of treatment for peripheral vascular diseases, with gratifying results. Progress notes are recorded, and treatment is changed or discontinued when warranted.

The average number of patients who receive physical therapy treatments during any one month is approximately 20 per cent, in the general medical and surgical hospitals 19 per cent in tuberculosis hospitals and 14 per cent in neuropsychiatric hospitals. The approved average ratio of physical therapy personnel to patients in general medical and tuberculosis hospitals is 1 technician to 100 patients and in neuropsychiatric hospitals is 1 to 200. At this time there are about 320 physical therapy positions established and approximately 62,000 hospital beds available. The physical therapy departments are prepared to care for the immediate foreseeable increase in patients with little additional space and equipment. However, it is estimated about fifty additional physical therapy technicians will be required when the present beds are fully utilized.

Physical therapy is an essential part of medical treatment in Veterans Administration hospitals and is effective in assisting in the restoration of normal function, in the alleviation of pain and in the shortening of hospitalization. The immediate and future plans for hospitalization of disabled veterans include further study and development of physical medicine as an important element in the rehabilitation program, particularly under war conditions.

OBSERVATIONS ON THE REHABILITATION OF WAR WOUNDED IN A NAVY PHYSICAL MEDICINE DEPARTMENT *

LIEUTENANT COMMANDER J. L. RUDD (MC) U. S. N. R.

Rehabilitation in time of war requires of the physical medicine departments of large naval hospitals that severely wounded patients, the type such hospitals usually receive, be returned as soon as possible to as useful a condition as possible.[1] Slightly wounded and even moderately severely wounded men are kept near the fighting front, where, even if they are unable to fire the guns themselves, they can be returned quickly to help those who are manning guns. This is of especial importance on a ship, where the care of the wounded has as its object the maintenance of the ship at the highest peak of efficiency. Under any and all circumstances the ship must continue to fight as long as she floats.

Number and Type of Treatments

The physical medicine department of the United States Naval Hospital in Philadelphia gives an average of 140 treatments a day exclusive of the Swarthmore Convalescent Annex and the occupational therapy department. Of the patients treated, about two-thirds are sailors or marines, and some are veterans of the first World War. About a fourth of the treatments are given to men wounded in the present war.

In August the majority of the patients received more massage, hydrotherapy and exercise than infra-red irradiation, galvanic therapy, diathermy or ultraviolet ray therapy. Recently a number of patients have had local treatments with saturated-air fever therapy machines. The units used (one for torso, one for extremities), operate at 112 to 118 F., with a relative humidity of 100 per cent, producing a deep tissue temperature said to be as high as 107 F. With this therapy we were able to improve some burn contractures and a few adhesions. Some of the results were encouraging, and this method will be reexamined as time passes.

Predominance of Injuries of Extremities

In this as in other wars, disabilities of the extremities are more common than those of other parts of the body. Also, more patients with wounds of the extremities than with wounds of other parts of the body are being sent into the department for rehabilitation. The reasons for both of the foregoing facts are simple: 1). In comparison with other parts of the body, the extremities are more often struck. 2). Physical agents are not likely to be applicable to the casualty who is hit somewhere, for instance in the abdomen, chest or head. 3). Many persons wounded in regions of the body more vital than the extremities do not survive.

We have records of the treatment of fractures of the extremities from Jan. 1 to Aug. 30, 1943, inclusive. In these cases we used the warm whirlpool bath if the patient was referred to us within three to six weeks after injury, or was sent to us soon after the injured limb was out of the cast. If the patient was referred to us later, we preferred the diathermy induction

* The opinions and asserations contained herein are the private ones of the writer and are not to be considered as official or reflecting the views of the Navy Department or the naval service at large.

* Read at the Twenty-second Annual Session of the American Congress of Physical Therapy, Chicago, September 10, 1943.

coil, since a deeper heat penetration was needed. In either case the selected method was followed by massage and exercises. The patients included those to whom the Stader apparatus had been applied. Some had a fractured calcaneus from which the Stader pins had been removed after six weeks of external skeletal fixation. For three weeks after the removal of the Stader splint, daily whirlpool baths, massage and non-weight exercises were prescribed. After this, weight bearing with support was followed by weight bearing without support.

Patients with ulnar nerve injuries, with injuries of the brachial plexus, with injuries of the sciatic nerve and with injuries of the radial nerve were treated with infra-red rays, massage, slow (galvanic) sinusoidal and interrupted galvanic stimulation followed by exercises when indicated. These patients were difficult to treat because there were serious residual paralysis and limitation of motion with atrophy, fibrosis and contracture. Nevertheless, in a recent 14 case series (6 of ulnar, 5 of brachial, 2 of sciatic and 1 of radial nerve injuries), improvement was noted in 5 cases and complete recovery in the rest. Of the 5 patients not completely recovered, 2 had both a fracture and an injury to a nerve. The 9 remaining patients regained complete use of the limb because (1) the nerve had regenerated, and (2) the musculo-articular system had been kept in good condition by the use of physical methods.

A few patients who had undergone exposure, who had been subjected to amputation, who were suffering from mild war neurosis or who had sustained burns were treated.

The young adults who had undergone exposure (immersion foot) were out fifteen days in an open boat in the gulf stream with their feet in the water most of the time. The water had not been very cold, and so physical measures consisted of tepid whirlpool baths at 82 F. and effleurage daily, with general ultraviolet ray treatment three times a week. Had they been treated in the acute stage after long immersion in cold water, dry cold would have been applied continuously for ten to fourteen days at 75 to 80 F.

The patients who had been subjected to amputation, and often they were suffering from neurosis as well, were given treatment in the Hubbard tank with the water at a temperature of 100 F. The warm water had a soothing effect, and the electric turbine ejector and aerator exerted a hydro-massage effect on the stump. Treatment in the tank was followed by manual massage, exercises and stump-toughening procedures. All of the foregoing measures were effective in relieving phantom limb pain and loosening adhesions that caused sensations of tightness and stiffness in the stump. The joint proximal to the injury was exercised to prevent muscular atrophy and to prepare the stump for an artificial limb. One patient at present uses his right arm to resist the movements of the left arm stump. (He uses resistance against the movements of the stump, which is put through the required ranges of motion. This has resulted in increased strength of all the shoulder muscles.)

Experience With Old Injuries

Many of the patients we encounter require more concentrated, more detailed and longer treatment than usually is needed. The patients often have waited many months in various parts of the world, receiving preliminary treatment, before physical therapy can be effectively employed. They present adhesions, contractures, atrophy, shortening and changes in joints. It is our task, in conjunction with the orthopedic and neurologic services, to attempt to overcome the established state and strive for a more nearly normal condition.

Exercises, electrical stimulation, manipulations and occupational therapy, in addition to many of the other methods used in a well equipped physical therapy department, are employed. In some cases, before it is possible to start active exercises, it is necessary to convince the patient by the use of passive or electrically stimulated motion that some action of the injured muscle or limb can be elicited.

In rehabilitating men wounded in war we find ever increasing use for, and encouraging results from, active resistive exercises. Among relatively young men who can stand the strain, we have evoked much enthusiasm and cooperation. With the patient working, usually against the operator's resistance (concentric force), or with the operator working against the patient's resistance (eccentric force) there results after a time an appreciable increase in the size and strength of atrophied muscles. Muscle groups and joints are worked in unison; later, gentle stretching or manipulation helps break down adhesions of skin to connective tissue and muscles, or adhesions of traumatized muscles and tendon to bone. All this is preceded by the application of some form of heat and gentle massage and when necessary by pétrissage and friction.

At all times we have tried to avoid causing pain or bringing on muscular spasm. In the case of a paralyzed muscle due to a nerve injury, exercises were stopped as soon as fatigue was noted. In most other cases a certain amount of fatigue, which cleared up before the next treatment, appeared to be beneficial.

Most of the service men treated were young adults. They were in good general condition. The elasticity and recuperative power that accompanies youth and good condition enabled them to fit into a regimen that most older or less "toughened" persons would not have been able to endure.

Report of Cases

Two cases now to be reported are representative of the type of patient treated, the preliminary treatment he receives, the physical therapy measures employed and the results obtained. They demonstrate the value of physical therapy in the clinical phase of rehabilitation.

CASE 1. — A marine corporal 28 years of age was admitted Jan. 21, 1943 with a diagnosis of "paralysis, partial, sciatic nerve, right." In a combat patrol on Guadalcanal in August, 1942, he had been hit by a burst from an automatic riflle and an explosive bullet had struck both thighs. After lying in the field for about forty minutes, he had been given first aid by a corpsman. This had consisted of injection of the contents of a syrette of morphine, dusting of the wounds with a sulfonamide powder and covering them with a sulfathiazole ointment, and application of gauze dressings and then bandages. He had been placed face downward on an improvised stretcher of canvas and had been carried this way for 8 miles through the jungle to the division hospital. Both legs had been paralyzed from the hips down. On the second day after his arrival at the division hospital, three bullets had been removed from his right thigh and the sciatic nerve sutured.

At a naval hospital dressings had been changed daily for two weeks and the left leg had been subjected to passive exercises daily for an hour. On the third day after the exercises had been begun, the patient had been able to move his left leg unaided. An attempt had been made to exercise the right leg in the same way, but the pain when the right ankle was grasped had been too severe.

When the patient entered the hospital at Philadelphia, he was unable to flex the right knee (normal flexion is considered 45 degrees) owing to his nerve injury and muscular atrophy. He had marked hyperesthesia of the lateral aspect of the foot, the ankle jerk was absent and there was generalized weakness of all the muscles of the leg, especially of the posterior tibial group.

Atrophy of the thigh, due to partial paralysis of the sciatic nerve, was recorded as of 1 inch and atrophy of the leg as of 3 inches. Foot drop was present, and the patient was unable to move his toes. On the right leg were the scars of three small

bullet wounds and one operative scar. When the right sciatic nerve and muscles were tested with the interrupted rapid sinusoidal current (substitute for the faradic current) and with the interrupted galvanic current, a full reaction of degeneration was noted.

On Jan. 26, 1943 treatment was started in our physical medicine department. From then until June 4, treatment consisted of exposure to infra-red rays, gentle massage (effleurage) followed by electrical stimulation, relaxed passive motion, active motion, active resistive exercises and some manipulation.

The patient gave up crutches and then his cane, and finally he was allowed to walk without his leg brace because his foot drop had improved. A partial reaction of degeneration was obtained in May. On September 1 flexion of the right knee was about 120 degrees (180 to 45 degrees is considered normal). The patient could flex and extend the right knee and ankle, and the foot was so much improved that his right foot easily cleared the floor when he walked. He walked with only a slight limp and could move his toes. Hyperesthesia was limited to a strip on the lateral edge of the foot and sole.

To recapitulate, the condition of the patient improved under resistive exercises, plus preliminary preparatory methods, even though nerve sensitiveness due to a traumatic neuritis persisted far beyond the usual period of one to six weeks and hampered treatment. The muscles were kept in as good a state of function as was possible while the nerve was regenerating. The joints were moved passively and actively to limit adhesions and prevent ankylosis. The patient was encouraged to walk with the aid of crutches, cane or brace to insure active motion of all the muscles of the extremity, and to use a support for the partially paralyzed muscles, when needed, while they were returning to normal. Electrical stimulation was used early to limit atrophy and maintain circulation until the muscles had begun activity and the slow sinusoidal or galvanic current was no longer needed. At the last visit he was able walk without any artificial support, although he still had a limp.

Case 2. — In December, 1942 a marine aviator sustained multiple injuries when his plane crashed on Guadalcanal. He was unconscious for five days and had severe burns on the right arm from wrist to shoulder, the right axilla and the right side of the chest. Skin grafts were applied before his transfer to the United States.

He was admitted to the United States Naval Hospital, Philadelphia, on July 26, 1943 as an outpatient. The donor areas on the thighs and lower part of the abdomen had healed. The right arm was reddened but was healed from wrist to shoulder. Extensive scarring of the cubital area prevented extension of the elbow beyond 110 degrees, and limited flexion to 85 dgrees. (Extension of the normal left elbow was 45 to 180 degrees, and flexion was 180 to 45 degrees.) The right shoulder was limited in flexion to 65 degrees and in abduction to 95 degrees. (Normal shoulder flexion is 180 to 0; extension is 0 to 180.) The circumference of the right arm was 9¾ inches, while that of the normal left arm was 11½ inches. There was a thick, contracted scar of the right posterior axillary fold.

It was the opinion of the surgical staff that the patient should have a course of physical therapy before resorting to plastic surgery. He was admitted to the physical medicine department on July 26. In view of the stage which healing had reached at that time and because previous stretching had caused slight tearing around the contractures at the shoulder and elbow, it was considered advisable to give saturated-air fever therapy for one and one-half hours three times a week. "Kneading" and frictional massage, manipulations (stretching or forced movement), passive motion, active motion and, especially, active resistive exercises daily were prescribed.

On October 15 the patient's condition was markedly improved, as shown by the figures in the accompanying table. The skin was much softer and smoother and was

Improvement in Case 2

	Normal, Degrees	Before Treatment, Degrees	After Treatment, Degrees
Elbow —			
Extension	45-180	110	145
Flexion	180-45	85	35
Hyperextension	180-135	none	135
Inward rotation	180-0	none	none
Outward rotation	0-180	none	none
Shoulder —			
Abduction	0-180	95	145
Flexion	180-0	65	35

Circumference of right arm: 9¾ inches before treatment; 10¾ after (normal arm: 11½.)

losing its scarred, mottled, ichthyotic, leathery appearance. The periarticular contractures at the elbow were loosening, and circulation and elasticity of the scar tissue over the olecranon was returning as a result of the heat therapy, frictional massage and manipulation.

The patient was very cooperative and enthusiastic because of the increased usefulness of his right arm. Owing to its improved appearance and greater mobility there is hope for its return to normal without further plastic surgery.

Summary

The general treatment for rehabilitation of men injured in war consisted usually of the application of heat or hydrotherapy in some form to prepare the skin and underlying tissue, massage, passive motion to test the safe and comfortable range of motion of joints and the elasticity of muscles and then slow sinusoidal or interrupted galvanic stimulation to exercise muscles suffering from flaccid paralysis. As soon as possible, active assistive exercises, active exercises and active resistive exercises were tried. As the strength of the muscles increased, active free exercises and active resistive exercises were given for longer periods and with heavier loads, according to individual abilities and reactions.

Younger patients and those in good condition could endure the strenuous forms of physical therapy with definite benefit.

The physical medicine department was of assistance to the orthopedic and neurologic services in hastening the return to useful duty of many men wounded in war.

The present interest by staff members in, and their increased knowledge of, the practical aspects of physical therapy in rehabilitation augurs well for the even wider acceptance and use of physical measures after the war.

References

1. Coulter, J. S.: Physical and Occupational Therapy in Rehabilitation, Arch. Phys. Therapy **24**:295 (May) 1943.

2. Kovács, Richard: Physical Therapy in War; A Primer on Indications and Technic, Arch. Phys. Therapy **24**:197 (Apr.) 1943.

3. Ferguson, L. K.; Brown, R. B.; Nicholson, J. T., and Stedman, H. E.: Observations on the Treatment of Battle Wounds Aboard a Hospital Ship, U. S. Nav. M. Bull. **41**:299 (Mar.) 1943.

4. Crile, George, Jr.: Experiences of the Surgical Service of the United States Naval Hospital, Auckland, New Zealand, With Casualties from the Initial Solomon Islands Engagement, U. S. Nav. M. Bull. **41**:306 (Mar.) 1943.

5. Krusen, F. H.: Physical Medicine: The Employment of Physical Agents for Diagnosis and Therapy. Philadelphia, W. B. Saunders Company, 1941, p. 675.

A NEW APPROACH TO THE PROBLEM OF INCIPIENT AND RECURRENT MALARIA *

Preliminary Report

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The remarkable tendency of malaria to recur after seemingly adequate therapy, and the fact that many unsuspected cases of malaria are masked under the cloak of multiple and bizarre symptoms led us to undertake this study to see what could be accomplished in causing recurrence of symptoms in incipient malaria patients.

At the United States Naval Convalescent Hospital at Glenwood Springs, Colo., there are several excellent natural resources which can be used therapeutically. Among these is a natural hot vapor cave. This is in a mountain side and was used by the local Indians for years to cure many ills. It is heated by a hot mineral water spring which circulates through three caverns in troughs in the floor. The temperature of the water as it leaves the spring is 140 F. The temperature in the cave varies between 102 and 110 F., with a relative humidity of 87 to 93 per cent. The cave is large and affords a means of treating about 20 patients at one time.

Patients are treated in the cave for a total of twenty minutes in divided periods, ten minutes at first with a three minute rest, then seven minutes with a three minute rest and finally three minutes. The average oral temperature rise is 2 to 3.4 degrees (F.). They are then brought upstairs and placed on a plinth; they are wrapped in a sheet and wool blanket and allowed to cool gradually for one-half hour. Patients are treated daily.

With the rise of systemic temperature there results a general capillary dilatation and an increase in the circulatory rate of the blood and in the cardiac output. There is an increase in the velocity of the blood, and a slight gradual increase in the blood volume.[1-2-3] The increase in the number of circulating red blood corpuscles is principally from the splenic reservoir.[4] The altitude of Glenwood Springs, 5,740 feet above sea level, may play a minor physiologic role, as at such an altitude there results a slight polycythemia.[5]

Thus in the case of latent malaria, when the plasmodium remains in the stagnant capillary beds of the spleen, liver and other organs, the artificial raising of the systemic temperature causes a general capillary dilatation, with discharge into the peripheral circulation of red blood corpuscles with the dormant plasmodium, which within a period of twenty-four to ninety-six hours results in a typical malarial paroxysm. Often before the typical symptoms of malaria are observed, we have noted that the patient complains of splenic tenderness, which may or may not be associated with enlargement of the spleen. However, it should be noted that repeated recurrences of malaria can occur in splenectomized patients. Thus the spleen is not the only organ to harbor the dormant plasmodium.[6]

In all cases, when the malarial paroxysm has been initiated, there has

* The opinions and assertions contained herein are the private ones of the writers and are not to be construed as official or as reflecting the views of the Navy Department or the Naval Service at large.

been present a definite splenic enlargement, the spleen being palpable from 1 to 6 cm. below the left costal margin.

After a positive blood smear for the plasmodium is obtained, therapy is instituted in the form of quinine sulfate, 36 grains in three divided doses per day. Drug therapy is continued until the patient is afebrile for five days and the blood smear is negative for malaria. The patient is then returned to the department of physical medicine for five more fever sessions in the hot vapor caverns. During this time he continues to take quinine at the same dosage. The quinine is then stopped and the fever sessions continued for six days. In all patients treated so far, there has been a slight decrease in the splenic enlargement while they were receiving quinine; however, when both quinine and artificial pyrexia are used, there is a definite decrease in the size of the spleen. At the time of discharge from treatment the spleen has returned to normal size and is no longer tender. The patient is then observed for a period of one week, and if no relapse occurs he is discharged to duty.

To date we have treated 26 patients with incipient malaria. Of this group 8 or about 1 in every 3 patients treated, had a recurrence of their malaria. Following the combination of artificial pyrexia and drug therapy we have had no recurrence of symptoms.

Physiologically this type of treatment seems to have a sound basis. The general capillary dilatation and the associated increase in circulating rate of the blood, with the increase in the volume of cardiac output, bring into the systemic circulation the plasmodium, which can then be directly acted on by the quinine in the circulating blood.

In contrast to the use of epinephrine, which causes a peripheral vascular constriction and a dilatation of the vessels of the intestine and probably of muscle, with a constriction of the splenic capsule and trabeculae,[7] artificial fever results in a general capillary dilatation and a more complete emptying of the red blood corpuscles from the splenic reservoir and other stagnant capillary beds.

If such a procedure proves to have merit after an observation period of six to nine months, it will open up a new field in the care of incipient and refractory malaria, as well as malaria masked under a cloak of bizarre symptoms. The ordinary hypertherm in any hospital offers a means of inducing pyrexia, and hence treating incipient malaria. This would be an important step forward, as one of the greatest problems of this war has been the control of malaria. To date a large number of the casualties from the various theatres of operation are due to malaria.

In conclusion, a method is offered for the control of incipient and refractory malaria as well as masked malaria, by the combined use of artificially induced hyperpyrexia and quinine. We realize that further observation and time will be necessary for proper evaluation of this therapy. However, it is our hope that this preliminary report will stimulate others to try the procedure in order to aid in such evaluation, since physiologically the procedure seems sound, and our results so far have been gratifying. Follow-up studies of cases will be continued.

Report of Cases

Case 1. — M. M. C., a white man aged 47 years, was admitted to the hospital Aug. 6, 1943, with a diagnosis of occupational fatigue. He had been in the Southwest Pacific, but had never had clinical symptoms of malaria. He had received suppressive atabrine therapy as routine. While in this endemic malarial area, he gradually noted increasing fatigue and a loss of around 40 pounds in weight; these symptoms were associated with increasing nervousness. He was evacuated to the mainland and sent to the Glenwood Springs Naval Convalescent Hospital for treatment and rest. Owing

to his nervousness he was referred to the department of physical medicine, where he received treatment in the hot vapor caverns. After his first treatment he had a typical malarial paroxysm, and the benign tertian plasmodium was found in his smear. He was then given the routine therapy, as described, and he recovered rapidly. His nervousness disappeared, he began to gain weight and his symptoms disappeared. He was returned to duty and has had no recurrence of malaria.

CASE 2.— R. D. S., a Negro man, aged 23, was admitted to this hospital Sept. 21, 1943, with a diagnosis of malaria. He had had six recurrences of malaria while on duty in the Southwest Pacific, and had been evacuated to the mainland. Since March of 1943 he had had no recurrence of malaria, and he had received no malarial therapy since April, 1943. However, he still complained of fatigue and general intermittent aching. Our usual therapy was administered, and a typical malarial paroxysm developed after his fourth hot vapor treatment. The benign tertian plasmodium was found in his blood smear. After our routine therapy there were no recurrences of his symptoms. His aching ceased, and his fatigue disappeared. He was discharged to duty. Observation of this patient has not been over a long enough period for the final result to be evident. But it is interesting to note that he had had no recurrences of malaria since March and that artificial fever induced a typical recurrence.

Comment

In case 1 the bizarre, cloaked type of malaria is illustrated, with recovery after adequate combined artificial fever and quinine therapy. Case 2 illustrates the marked tendency of malaria to recur and its refractoriness to ordinary therapy.

References

1. Bazett, H. C.: The Effect of Heat on the Blood Volume and Circulation, J. A. M. A. **111**:1841 (Nov. 12) 1938.

2. ————: Blood Volume and Cardiovascular Adjustments, Am. Heart. J. **21**:423 (April) 1941.

3. Krusen, F. H.: Physical Medicine, Philadelphia, W. B. Saunders Co., 1941, p. 59.

4. Best, C. H., and Taylor, N. B.: The Physiological Basis of Medical Practice, second edition. Baltimore, The Williams & Wilkins Co., 1940, p. 84.

5. Mongs, C.: Chronic Mountain Sickness, Physiol. Rev., **23**:166 (April) 1943.

6. Fralick, H.: Personal Communications.

7. Strong, R. P.: Stitt's Diagnosis, Prevention, and Treatment of Tropical Diseases, 6th ed. Philadelphia, Blakiston Co., 1942, p. 105.

PROGRAM FOR REHABILITATION OF THE INJURED

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Michael Reese Hospital has a complete program for rehabilitation of the injured. This program includes a well-equipped and well-staffed physical therapy department, an occupational therapy unit and a shop for vocational training.

The physical therapy department is quartered in a new building, with numerous treatment rooms, a gymnasium and units for hydrotherapy, fever therapy, rhythmic suction therapy and colonic therapy. There is a therapeutic pool in the basement. The occupational therapy department has five divisions: a general occupational therapy division, a curative workshop, a pediatric occupational therapy division and an occupational therapy unit for mental diseases, as well as a craft shop used for the teaching of a trade, the program being a preindustrial one.

The chief objective of this program is to restore each patient treated to as near 100 per cent efficiency as possible. The aim is not only to rehabilitate a disabled part to full or to near-full function but to return the patient to his former occupation or if this is impossible to teach him another occupation and return him to society as a self-respecting and independent citizen.

It is well to describe one division at a time, give the routine and, finally, discuss the importance of tests and measurements to show how they fit into a well organized plan of rehabilitation.

Divisions

Underwater Gymnastics. — The equipment consists of a therapeutic pool, treatment rooms and an observation unit. This pool is 30 by 15 feet and is equipped with adequate accessories and an electric hoist and overhead trolley.

The pool can be very useful in industrial work in the treatment of the spine, injuries to the larger joints, low back injuries, tendon transplants, peripheral nerve injuries in the later stages and any traumatic condition in which there has been loss of muscle power. It is ideal for teaching patients how to walk, especially in the early stages of an injury.

The values of pool work can be summarized as follows:

1. Buoyancy — release from gravity pull.
2. Reduction of inhibiting muscle spasm.
3. Pleasurable activity — psychologic.
4. Activity in all planes.
5. Inherent stimulus to motion.

The Hubbard Tank Room. — The equipment consists of a large Hubbard tank with a manual hoist and a large treatment table. The tank can be used for industrial patients who need a more concentrated system of exercise and higher water temperatures, particularly patients with severe injuries of the spine, pelvis, hip or knee. We usually start such patients in the Hubbard tank and when range of motion is sufficient transfer them to the large pool.

Hydrotherapy. — Our hydrotherapy division consists of a room especially equipped with a large electric cabinet, a sitz bath, a complete douche table

and showers. In addition we have whirlpool baths, contrast baths, a mobile paraffin bath and a special machine for application of hot compresses.

Among the indications for hydrotherapy are sprains, strains, fractures—particularly recent fractures after removal of casts—painful stumps, peripheral nerve injuries and indolent ulcers.

Wax dips are used for fractures of the bones of the wrist and hand, stiffness of joints, scar tissue restricting the motion of joints and tendons and tenosynovitis.

Gymnasium. — The gymnasium is 25 by 15 feet. From the standpoint of industrial work we can use it for the more strenuous program of exercise

Fig. 1. — The whirlpool bath.

as the patient progresses. We have many devices which we use for stretching joints with a limited range of motion, for example a banjo splint for the wrist and fingers; a special device for the shoulder, elbow and ankle and still another for the knee. As range of motion and muscle power increase we use the stall bars, parallel bars and pulley weights to assist in the stretching program, and then we institute a graduated exercise program with flying rings, rope climbing, stair climbing, rowing machines, bicycles, etc. We have various-sized walkers and crutches and canes, all with the same object in view—to get the patient back to a normal walking gait as quickly as possible.

Rhythmic Suction Therapy. — One room is allocated to this form of therapy, and our equipment consists of two rhythmic suction machines, two rhythmic constrictors (to be used in the wards) and necessary associated apparatus.

The term pavex is often used to describe this type of therapy and means passive vascular exercise. This is a physical method used after the major or secondary arteries have been obliterated by trauma or arterial disease to assist in the prevention of serious sequellae, by gradual dilation of collateral circulation in the extremities. It is used in cases of frostbite.

Electrodiagnosis. — Many patients are tested electrically for a reaction of degeneration. The apparatus consists of a faradic coil and a galvanic machine.

Apparatus and Treatment Rooms. — The treatment rooms are equipped with

treatment tables, exercise tables and special equipment for exercise purposes. We have apparatus of the latest make, including infra-red and radiant light lamps, bakers, long wave diathermy machines, short wave machines, galvanic and sinusoidal machines and ultraviolet light lamps.

Related Divisions. — Divisions not included in the department related indirectly to industrial work are the divisions of fever therapy, electrosurgery, ultraviolet therapy and research and teaching.

Fig. 2. — A machine for passive vascular exercise of the extremities.

Tests and Measurements

Tests and measurements play an important part in industrial medicine. It is important that progress notes be kept and the percentage of disability be accurately recorded. Accurate measurements of the range of motion furnish objective evidence on the basis of which the physician and the industrial insurance company may gage the improvement or lack of improvement in the course of treatment instead of relying on subjective impressions.

One of the greatest values of joint measurements lies in the psychologic effect on the patient, who becomes interested in the progress of his own case.

In daily practice such measurements furnish the best possible guide to the direction of treatment itself, and, finally, when the treatment is finished, they furnish valuable data by means of which results can be stated and studies can be made.

They are indispensable in medicolegal work. The justice of the compensation awarded depends on the accuracy of these records.

Other tests used are the functional muscle test, strength tests, electrodiagnostic tests and tests for accuracy of motion, speed of movement and endurance.

Occupational Therapy Facilities

The conventional impression of occupational therapy as a good means of keeping the patient out of mischief by giving him a long-time, routine job of making baskets or hooking rugs is a thing of the past. The patient must be considered as a whole and everything done to restore him to as near normal function mentally and physically as possible.

Michael Reese Hospital's existing occupational therapy facilities can be utilized in a well rounded program of rehabilitation for the handicapped. The

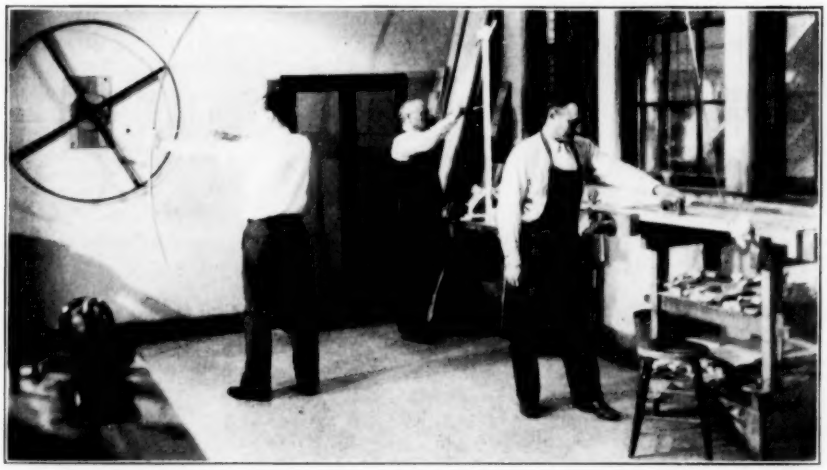

Fig. 3. — A section of Curative Workshop showing methods of rehabilitation of upper extremities.

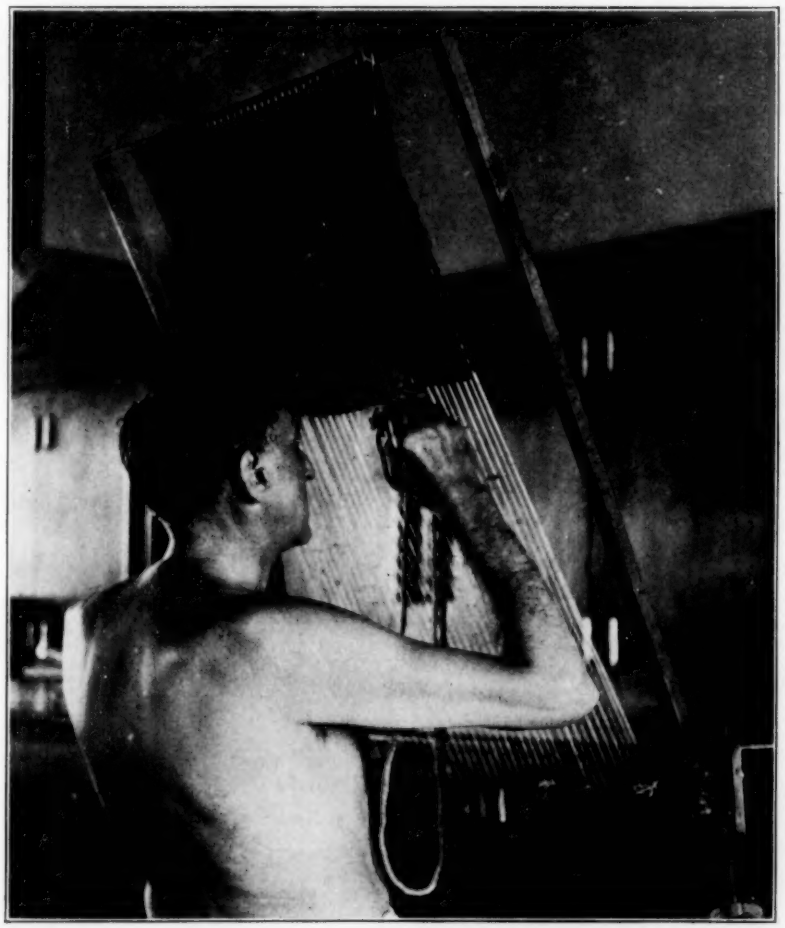

Fig. 4. — Rug making for rehabilitation of shoulder.

workers are taught skills, crafts and the use of machinery while their injured muscles and joints are being reeducated. A preindustrial training period—the patient working for small compensation while learning a trade or skill under nearly ideal working conditions—is offered.

The present Hartman curative workshop and the general occupational therapy shop have a curative program with the following equipment:

Floor Looms: for leg, arm, and shoulder conditions.

Table Looms: for shoulder, arm, hand and finger exercise.

Bicycle Saws: for leg, finger, arm, wrist and foot exercise.

Electric Jig Saw, Lathe: for finger, hand, arm and shoulder exercise while the patient is learning the use of simple motorized equipment.

Small Hand Tools (with handles of graduated size): for exercise and testing of hand and finger injuries.

Hand Looms: for hand, wrist and finger exercise.

Piano: for finger exercise.

Typewriter and Other Office Equipment.

Gardening Tools: for all types of exercise under outdoor conditions.

With physical therapy doing the actual remedial work, occupational therapy and the other services provided by Michael Reese Hospital can combine to help the handicapped person to return to his former job or to one for which he is found to be better qualified. With these services the worker would be returned to industry sooner.

CENTER OF GRAVITY OF HUMAN BODY

With a Discussion of the Equipment of the German Infantryman

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Braune and Fischer were outstanding German anatomists of the late nineteenth century who became interested in biomechanics. In 1889 they published an exhaustive paper on an experimental method of determining the location of the center of gravity of the human body and its parts.[1] This was one of the first of a long series of publications covering many years of intensive research in the field of body mechanics. Braune and Fischer have been quoted widely and stand as the immediate precursors of the great anatomist Fick, who remains the leading authority on joint mechanics. Fick drew from the studies of these earlier authors, especially in regard to the physical problems of the erect stance. Thus, since Braune and Fischer appear to hold a summital place among students in the field of posture analysis, it was deemed expedient to prepare a full translation of their historically important paper of 1889 and discuss its implications in the modern study

of the vertical stance of man. This seemed particularly important because the only experimental evidence supporting our basic current posture concepts apparently stems from various interpretations of their classic work.

Prior to the publication of the paper of 1889 by Braune and Fischer, numerous other investigators had approached the problem of the location of the center of gravity of the human body. For the most part they either worked on the soft malleable body mass or reduced it to simple three dimensional geometric forms. Braune and Fischer recognized that it would be impossible to locate the center of gravity accurately by either of these methods and appreciated also that such a point, once located, would be valid for but a single body position, owing to the fact that the center of gravity of the whole must vary with each change in the alinement of its segmental parts. The common center of gravity of the erect living body had been ascertained by measuring the angular deviations of certain body parts as they moved away from an initial starting position. This method proved to be impracticable because of the difficulty of establishing an initial posture which could be reproduced both readily and accurately by the subject. In their approach to the problem, Braune and Fischer therefore introduced two basic modifications in procedure. First, they sought to render the nonliving body rigid and inelastic so that it would maintain its shape unchanged in a position which could then be defined with mathematical exactitude. Second, they reproduced this posture precisely in the living subject. Thus they demonstrated that a repeatable initial stance might be attained in terms of which all other postures could be analyzed through the application of suitable mathematical calculations.

Braune and Fischer stated their major premise approximately as follows: A precise knowledge of the position of the center of gravity of the entire body and, above all, of its separate parts, associated with knowledge of their combined weights at their centers of gravity, is indispensable for an elaboration of the laws of the statics and mechanics of the human body. Only through the application of these will one be able to judge the forces which the muscles will have to overcome during movements of the body.

The effect of the gravitational force of the earth can be visualized in the following way. A force acts on the center of mass of a body in the direction of a line joining it with the center of the earth. The magnitude of the force is equal to the weight of the mass which is centered at the "*Massenpunkt.*" Owing to the great distance of the center of the earth, all these vectors of force are parallel with each other. There exists therefore a resultant of the gravitational forces. For any position of the body this resultant corresponds to a constant straight line within that body.

This straight line remains unchanged if one shifts the body parallel with itself in space for not too great a distance. But it does change its position within the body immediately when it is rotated. The straight line in the new position cuts the old line at a certain point. Through the same point pass also all the other straight lines which constitute the positions of the resultants of the forces of gravitation after renewed rotations. Therefore one can consider this point of intersection as a joint point of action of all the resultants of the forces of gravitation for any position of the body. This point is the center of gravity of the body. The magnitude of the resultant is the weight of the body. Since the resultant equals the sum of the individual forces of gravitation, the weights of all the individual body parts, therefore, can be considered to be within the center of gravity of the body. The direction of this resultant shall be named the weight line. Consequently the weight line is the line connecting the center of gravity with the center

of the earth. It does not change, therefore, its absolute position in space if the center of gravity remains stable, though the body may be rotated around its center of gravity in any direction. On the other hand, it does change its relative position to the body with each rotation of the body around the center of gravity. As long as the weight line cuts the supporting base of the body, it will maintain its balance, but as soon as it falls outside of the base, the body will fall.

The base of support is not identical with the surface with which the body actually touches the ground. It is the same only when it consists of one piece and the periphery is convex all around, as, for instance, in the case of an inverted cone. On the other hand, if the periphery is indented, i. e. is concave in some parts, that area which lies within the double tangents of the indentations is included as part of the base of support. If the indentation extended through the base of support, i. e. a base with two or more separate parts, these facts would not be changed. In each case, the entire space between the two double tangents is a part of the supporting base.

Consequently the base of support for the human body in the upright position on both feet would be determined by the surfaces of the soles of both feet and by the space which lies between the two double tangents which have to be drawn from the tips of the toes to the projection of the heels.

Man can reduce his base of support in the upright position to a minimum by standing on one leg and rising on tiptoe. The supporting base is at its maximum if both legs are brought into greatest abduction. This is a position which one assumes instinctively in fencing or while standing on the bottom of a swaying boat, since the weight line can then execute considerable shifting without falling outside of the base of support. The center of gravity can assume three different positions in relation to the supporting base, namely, above, below or coincident with it. In the case of the human body in the vertical stance, the center of gravity is located relatively high above a small supporting base, so that the total mass is placed in a state of unstable equilibrium.

Certain difficulties are encountered when one attempts to establish the exact point at which the center of gravity is to be located within the human body:

> Since the human body does not consist of a rigid mass, but of movable parts which are continually changing their positions in relation to each other and cannot, even in themselves be considered rigid in a mechanical sense, and since also, flowing fluids are present in the body, the question arises whether, after all, one can speak of a center of gravity of the living body. In the absolute sense, certainly not.[1]

We ourselves have demonstrated that an incessant shifting of the common center of weight occurs in the upright stance and that this is of a magnitude sufficient to consider standing movement on a stationary base.[2] Mosso had in fact proved in earlier experiments that the position of the common center of gravity of the body is continually changing even in recumbency, owing to movements associated with respiration and the circulation of the blood.[3] More recently Cotton has demonstrated that center of gravity displacements related to respiration are sufficiently great to distinguish between its thoracic and abdominal components.[4] Numerous investigations of recent decades indicate further that the filtration of fluid in the tissue spaces of dependent parts associated with simple stagnation in a widening vascular bed secondary to the hydrostatic effect of gravity on the circulation combine to produce shifts in body fluids which must have a significant effect on the location of the center of gravity in the vertical stance.[5] In their aggregate, these uncontrollable variables appear to have an effect perhaps not adequately weighed by Braune and Fischer. They believed the errors resulting

from involuntary movements and shifts in body fluids were too small to be of practical importance in the eludication of the static and mechanical laws affecting the human body. Recent evidence stands to the contrary, unless one limits his study of posture to momentary assumptions of the vertical stance. With these thoughts in mind, it is interesting therefore to examine into the details of the procedure used by Braune and Fischer in their location of the center of gravity of the human body and evaluate its validity. Their paper of 1889 still stands as the only extensive attempt to arrive at a three dimensional location of the center of gravity in the erect subject.

The basic observations of Braune and Fischer were made on four cadavers. To avoid distortion due to softness of the material, while still in rigor mortis, these were frozen solid on a horizontal board in the symmetrical supine position without the head being raised. The legs were extended and rotated somewhat laterally. The elbows were slightly flexed and the forearms were in the midposition. The cadavers were made hard enough to remain rigid throughout the period of the examination. The method of suspension was used to obtain the common center of gravity of the body as a whole and that of its dismembered parts.

The entire body was first suspended from strong unyielding steel spits thrust perpendicular to the cardinal orientation planes. The spits were well hardened and had long tapering points so that they could be easily driven in one direction with a blacksmith's hammer, passing through all tissues of the solidly frozen body, including the bones. Since they were round, they constituted an axis about which the body could rotate easily and swing until the center of gravity placed itself perpendicularly below the axis. With the help of two plumb lines attached to the axial rod, the plane was then determined in which the center of gravity was situated and a transverse line was scratched on the surface of the body. One was introduced so that it stood nearly perpendicular to the transverse plane in the longitudinal axis of the body. The second axial rod was hammered in the saggital direction and the third frontally. After that the body was sawed through in the transverse plane and threads were extended over the hard cut surface connecting the points which had been scratched on the surface of the body. Thus the intersection of the transverse plane with the two remaining planes was determined, locating the center of gravity of the body as a whole.

Four cadavers were available for experimentation, but all could not be used for the full series of calculations. The first was that of a well built muscular young man of 18. The second was a very muscular man of 45. The third was a normally built extremely muscular handicraft man of approximately 50. The last was a muscular workman whose age was not given. All had committed suicide, the first by shooting and the others by hanging. The first was not allowed to be sawed apart and the second began to thaw before the measurements could be completed. Thus, all the calculations were carried out on only two bodies. The common center of gravity was determined in three and found to be located as follows: Cadaver I (169 cm. tall): at the level of the lower rim of the second sacral vertebrae, 0.5 cm. to the right of the midplane, 4.5 cm. below the promontory, within the plane passing through the promontory and the center of the heads of the femurs. Cadaver III (166 cm. tall): at the level of the lower rim of the first sacral vertebra, 0.2 cm. to the right of the midplane, 4 cm. in front of the superior transverse line of the sacrum. Cadaver IV (168.8 cm. tall): at the level of the upper rim of the third sacral vertebra, 7 cm. in front of it and 7 cm. above the upper rim of symphysis, within the midplane of the body. All three of the gravity centers were found to lie in the cavity of the pelvis minor.

By applying the same method, Braune and Fischer determined the location of the center of gravity for each part of the body. The right extremities were somewhat heavier than the left. It was observed that a close relationship existed between the location of the center of gravity of the separate parts of the extremities and the contiguous joint centers, lying on a straight line connecting the centers of the joints and dividing this in the proportion of 4 to 5.

Braune and Fischer took advantage of the regularity in the position of the center of gravity of the separate parts to construct an upright body position in which all of the centers of gravity other than those of the feet, came to lie within the transverse vertical cardinal orientation plane. A drawing of a skeleton was reconstructed on millimeter graph paper in frontal and profile view, life size, in accordance with the measurements of cadaver IV. The joint axes and the center of gravity were thus easily fitted into a right-angled coordinate system. The contours of the soft parts were then sketched around the figure to make for a more satisfactory comparison with the living. It was next determined whether the constructed position is possible in the living and how nearly the horizontal supine position of a cadaver frozen while still in rigor mortis can be transposed to the upright position of a living man.

The subject used for the final photographic analysis of the upright posture was a muscular, well built soldier with body measurements approximating closely those of the original cadaver. The midpoints of the joints and the estimated center of gravity of the head were projected onto the body surface and marked. These included all of the major joints except the small ones of the hands and feet and those of the vertebral column. It is well to remember that the midpoints of the joints are not necessarily coincident with the axes of rotation and that the latter must be known if rotational stresses are subsequently to be determined from photographic evidence. Two long plumb lines were hung on each side of the subject to represent the coronal plane. The soldier now adjusted his position until he had assumed, by voluntary effort, that specific posture which enables an observer at a distance to sight all the marked joint centers along the frontal plane indicated by the plumb lines. A profile photograph was then taken and compared directly with the life-sized drawing constructed from the measurements made on cadaver IV. There was a marked similarity between the two. Braune and Fischer therefore felt justified in concluding that their arbitrary starting position could be considered a natural and not a forced one, although there were certain differences between the two. For example, the thorax protruded farther forward in the living subjects, and there was a more marked lordosis than in the skeleton drawn to measure. Braune and Fischer felt these differences to be indicative only of individual variation and hence of no importance to the main objectives of the experimental study. This view may be challenged. Indeed, Fick[6] subsequently concluded that one cannot transfer the lying position of the frozen cadaver into the vertical stance. In the main, the lumbar lordosis in recumbency is much less marked than in standing, during which the center of gravity of the body as a whole shifts forward considerably more than Braune and Fischer assumed. However, the principle structures, such as the alinement of the lower extremities, the position of the pelvis and that of the head, corresponded well to those of the constructed skeleton. Thus Braune and Fischer believed they had succeeded in finding a more or less natural upright stance of the human body which could be standardized with sufficient accuracy to provide an initial position from which the location of the center of gravity

of the body as a whole could be calculated by the application of certain mathematical formulas, derived from the estimated location of the center of gravity of the separate parts, as four-ninths of the distance between contiguous joints. This posture they termed the *Normalstellung*.

Translated literally, *Normalstellung* means normal position. The term was unfortunate. It is not a "normal" stance in the ordinary sense of that word, but was used as a standard, or reference position. Later workers seem to have taken the word *Normalstellung* to mean ideal posture. Braune and Fischer's original figure became stylized and was gradually accepted as a model of the most perfect stance attainable by man.

Fick differentiated strictly between the *Normalstellung*, or normal position, and the *Normalhaltung*, or normal posture. The latter does not exist, in his estimation, and it is useless to try to find a scientific norm for the purely individual manner in which peoples of different races and fashion stand.

After a practical initial posture which could be assumed readily by the living subject had thus been created, experiments were carried out to determine the shift in the common center of gravity in other positions. By measuring the number of degrees a part had rotated away from the original frontal plane, Braune and Fischer could, by reference to the three dimensional construction of the skeleton of cadaver IV, calculate how much the movement had altered the position of the body's common center of gravity. Diagrams of the subject's supporting base were drawn on coordinate paper. Into these were projected the center of gravity of each stance related to three points, namely, the center of talotibial joint, the center of gravity of the feet and, finally, the projection of a line connecting the centers of the two hip joints. From these diagrams it was possible to estimate the amount and distribution of static security in different postures.

Seven stances were analyzed. Each was studied in detail. In those positions which involved the carrying of military equipment, the center of gravity of the articles carried was determined first, and then its effects on the subject's common center of weight were calculated by means of the coordinate system.

In the comfortable posture the weight line fell 4 cm. in front of the center of the talotibial joints, that is, considerably behind the center of the supporting base. Since the center of gravity was arrived at by calculation from a profile view photograph, its vertical projection was always drawn within the midline of the supporting base on the assumption that the total weight of the subject was symmetrically distributed. Braune and Fischer concluded that the comfortable posture was a much more stable one than the *Normalstellung*, in which the weight line passed through the ankle joints.

In the military position the weight line fell 7.2 cm. in front of the ankle joints, but still somewhat behind the center of the supporting base, closer to the balls of the feet than to the heels. It was therefore a position unstable with regard to a force acting from behind. Braune and Fischer considered it an extremely uneconomical stance. They believed it caused considerable muscular strain if maintained for any length of time, a deduction doubtless attempting to explain the sensations of fatigue and the syncope long known to accompany prolonged rigid standing. Recent studies indicate that these symptoms are primarily the result of orthostatic circulatory insufficiency rather than of actual muscular strain; for the energy metabolism of the vertical stance is augmented but little above that characteristic of horizontality.[7] Braune and Fischer pointed out the undenied advantage of

the military stance as a position of readiness, assumed for the purpose of releasing rapidly the initial step for marching.

In the military stance with full equipment and rifle, the weight line fell slightly in front of the center of the supporting base. In order to determine the efficiency of the pack system and the suitability of the height of the pack, the displacement of the weight line caused by the pack alone was calculated. It was found that the center of gravity was shifted backward 1.9 cm. This was considered to be a small displacement of the weight center. Braune and Fischer offered this measurement as an indication of the efficiency of the pack system. They realized, however, that the method had limitations, and that the consideration of the location of the gravity center and its vertical projection was only one factor indicative of the degree of security of the stance, without disclosing any direct information as to the muscular strain involved or the efficiency of the position for activity.

Braune and Fischer were interested enough in the practical application of their fundamental stance concepts to carry out a few experiments on the influence of load and pack position on the ability of the subject to ascend an inclined plane. The equipment consisted of a strong wooden board which could be tilted to different levels of inclination. Three soldiers acted as subjects. At an incline of 32 degrees the officially equipped soldier was able to maintain balance, but was incapable of taking a step forward. Without equipment, carrying the knapsack on his head and the cartridge belt around his neck, the subject could then step forward when strips of wood were nailed across the board to prevent slipping. On inclines of the following average degrees, the soldiers were just able to maintain their balance: (*a*) standing with equipment, 41 degrees; (*b*) standing without equipment, 48 degrees; (*c*) standing with knapsack on chest, 51 degrees. From this it was concluded that a load carried low on the back necessitates more forward bending on a steep surface than a load carried high. The low pack causes a greater backward shifting of the common center of gravity than the high pack, because the flexibility of the back in the forward direction is greater in the upper than in the lower region, facilitating autonomous compensatory realinements.

In the same way as the displacement of the center of gravity due to equipment necessitates the forward bending of the trunk in order to bring the center of gravity over the middle of the supporting base, the loading of the body in the region of the lower back will cause autonomous changes in position. The body will bend forward in order not to fall backward. This bending will be greater the steeper the plane and the farther backward the center of gravity is displaced. This bending is feasible only in the ankle joints, the hip joints and the vertebral column. Persons with stiff joints, older people, generally, will be more hindered in mountainous areas than young people with flexible joints. It is conceivable that a shifting of the load to the upper region of the back will facilitate this correction of the location of the center of gravity by the bending of the body, because here the sum of the vertebral joints adds to the flexibility.

It is neither accident nor fashion which decrees that loads shall be carried in the middle of the back in the northern plains of Germany, whereas everything heavy is shifted to the head or as high as possible on the body in the mountainous regions of southern Germany and in the Alps. In the *Berner Oberland* of Switzerland cheeses weighing 100 pounds are placed high on the back, and the girls of Capri carry the heaviest luggage and loads of bricks over the steep road to Anacapri on top of their heads.

Thus Braune and Fischer completed their study, merely hinting at the

practical consequences of an examination of the location of the center of gravity, without trying to step into a field in which they believed themselves to be less competent than the military authorities. Their work had a great impact on subsequent thinking in the field of animal mechanics.

The major premise of the procedure described by Braune and Fischer is acceptable within the limits carefully presented by these investigations. They put aside any serious consideration as to whether or not the *Normalstellung*, on which all their stance analyses were based, was a comfortable posture. They had only one aim in its presentation, that of arriving at a practical initial position, easily reproducible in the living subject and amenable to precise mathematical description. Nothing in their writings indicates a belief that the limb systems would spontaneously aline themselves in a common frontal orientation plane. Indeed, they themselves reiterated again and again that the multijointed human body is so constructed that it automatically assumes a position which will bring the weight line as nearly as possible to the middle of the supporting base. To achieve this, which is the single most important tenet of physiologically normal standing, one arrives at an alinement wholly incompatible with the distribution of the parts in the *Normalstellung*. Care should therefore be taken not to imply that the *Normalstellung* is the ideal posture of man, for this concept does violence to the purely experimental purposes for which it was originally conceived.

References

1. Braune, W., and Fischer, O.: Über den Schwerpunkt des menschlichen Körpers mit Rücksicht auf die Ausrüstung des deutschen Infanteristen, Abhdlg. d. Kgl. Sächs. Ges. d. Wissenschaften **26**:561 (Sept.) 1889.

2. Hellebrandt, F. A.: Standing as a Geotropic Reflex, Am. J. Physiol. **121**:471 (Feb.) 1938.

3. Mosso, A.: Application de la balance a létude de la circulation du sang chez l'homme, Arch. ital. di biol. **5**:130, 1884.

4. Cotton, F. S.: Studies in Center of Gravity Changes. No. 3. An Investigation of the Sex Difference in Respiration, by Measurement of the Respiratory Variation in the Center of Gravity, Australian J. Exper. Biol. & M. Sc. **10**:97 (June) 1932.

5. Thompson, W. O.; Thompson, P. K., and Dailey, M. E.: Effect Upon Composition and Volume of Blood in Man, J. Clin. Investigation **5**:573 (June) 1928;

Turner, A. M.; Newton, M. I., and Haynes, F. W.: Circulatory Reaction to Gravity in Healthy Young Women; Evidence Regarding Its Precision and Its Instability, Am. J. Physiol **94**:507 (Sept.) 1930;

Waterfield, R. L. The Effects of Posture on the Circulating Blood Volume, J. Physiol. **72**:110, 121 (June) 1931;

Krogh, A.; Landis, E. M., and Turner, A. H.: Movement of Fluid Through the Human Capillary Wall in Relation to Venous Pressure and to the Colloid Osmotic Pressure of the Blood, J. Clin. Investigation **11**:63 (Jan.) 1932;

Youmans, J. B.; Wells, H. S.; Donley, D., and Miller, D. G.: The Effect of Posture (Standing) on the Serum Protein Concentration and Colloid Osmotic Pressure of Blood from the Foot in Relation to the Formation of Edema, J. Clin. Investigation **13**:447 (May) 1934;

Wells, H. S.; Youmans, J. B., and Miller, D. G.: Tissue Pressure (Intracutaneous, Subcutaneous, and Intramuscular) as Related to Venous Pressure, Capillary Filtration, and Other Factors, J. Clin. Investigation **17**:489 (July) 1938;

Asmussen, E.; Christensen, E. H., and Nielsen, M.: Heart Rate and Body Position, Skandinav. Arch. f. Physiol. **81**:190 (March) 1939;

Mayerson, H. S., and Burch, G. E.: Relationships of Tissue (Subcutaneous and Intramuscular) and Venous Pressures to Syncope Induced in Man by Gravity, Am. J. Physiol. **128**:258 (Jan.) 1940.

6. Fick, R.: Handbuch der Anatomie und Mechanik der Gelenke, Bardeleben's Handbuch der Anatomie des Menschen, Vol. 2, 1st division, part 3, Jena, Gustav Fischer, 1911.

7. Hellebrandt, F. A.; Brogdon, E., and Tepper, R. H.: Posture and Its Cost, Am. J. Physiol. **129**:773 (June) 1940.

ELECTRODIAGNOSTIC INTERPRETATIONS IN NERVE LESIONS *

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Electrodiagnosis in nerve lesions does not mean the mere application of electrical stimuli to tissues and the observation of the effect produced. This technical aspect of the operation requires skill and patience but it can readily be learned. The interpretation of findings is not so easily acquired. It demands a knowledge of the principles governing the stimulus employed and an awareness of the sources of error.

Physiology of Electrical Stimulation

It is generally accepted that excitable tissues are polarized structures; that is to say that at rest they have an electrical charge across a limiting surface. In the case of nerves, the negative charge is known to be on the inside and the positive on the outside. During phases of activity, these charges neutralize one another. Moreover, artificial neutralization from outside sources constitutes a stimulus which provokes activity. It follows that a negative potential of appropriate value will, by neutralization of the positive charge on the outside of the charged surface of a nerve fibre, initiate a nervous impulse. Similar considerations apply to the other excitable tissue with which we are concerned, namely muscle.

For the electrical stimulus to be effective, a potential of a definite value has to be impressed across a structure which is not only polarized but which continually attempts to defeat efforts to depolarize it. Because of this, a time factor creeps in when a current is used to produce the necessary potentials. When the minimal currents necessary to elicit responses are plotted against the duration of flow of the current, the points indicating the relationship between the two are found to lie on double asymptotic curves. Such curves are characteristic of the excitability of the structure for the existing circumstances, and can be the means by which normal muscle fibers can be distinguished from denervated ones. The two curves in Fig. 1 show how the I/T (intensity duration) curve of a normal muscle, stimulated by way of its motor nerve, essentially differs from one with fully established axon degeneration of its nerve supply.

The potentials locally required to initiate nervous impulses or muscular contractions are minute and there is little difficulty in producing them in isolated preparations, whether in the physiological laboratory or during an open operation. Under such conditions, the current densities needed in the immediate neighborhood of the structure to be stimulated are readily obtained by the use of small currents. Away from the physiology bench and the operating table, considerably larger currents are required in order to obtain the same densities around this structure which lies deeply buried and is surrounded by other tissues. Only a small fraction of the total current used is then effective. The major portion is wasted by leakage along inert structures or perversely engaged in stimulating other excitable tissues.

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Comparisons of Normal and Abnormal Fibres

The main features which characterize the two types of muscle fibres involved in our problem are quantitatively the I/T curve, and qualitatively the brisk as distinct from the sluggish response of the muscle fibre. When a muscle is homogeneously composed of one or the other type of fibre it is easy to ascertain to which it belongs. It is when mixtures of the two are concerned that difficulties of detection and interpretation present themselves.

In order to extract the maximum useful information from the transcutaneous method of muscle testing, it is necessary clearly to visualize the effect of electrical stimulation on muscles compounded of varying ratios of the two types of fibre. To this end, it is important to possess a vivid conception of the changes resulting from a progressive increase in the quantity of denervated muscle fibres with the consequent proportionate decrease in normal fibres. These modifications are expediently conceived and expressed in terms of twofold I/T curves. Fig. 2 consists of some sets of curves graphically depicting representative phases during this gradual change. In the case of mixed fibres, two separate curves are shown. Each is the I/T curve of the aggregate of one type of fibre at a moment when axon degeneration is fully established and no recovery has occurred. The durations of flow of

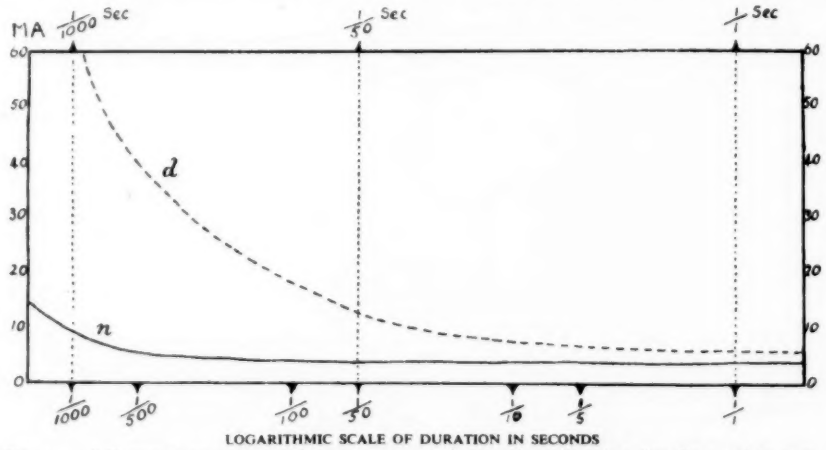

Fig. 1. — I/T curves or normal and denervated muscles showing characteristics discussed in text.

the current are measured in seconds along the abscissa on a logarithmic scale, while the threshold currents in milliamperes appear along the ordinates on a linear scale.

In Fig. 2 (A) the typical I/T curves of a normal and of a fully denervated muscle are shown for the sake of reference. It should be noted how the d-curve rises progressively with decreasing durations while the n-curve has an initial portion which is parallel to the abscissa. In Fig. 2 (B) are shown the I/T curves of the normal and denervated components of a muscle the motor nerve of which has been partially destroyed. In this particular case, there is but a small proportion of denervated muscle fibre and the normal fibre component has a lower threshold for all durations than the denervated component.

It is clear that the denervated fibres will remain undetected, and that with currents below their own threshold, they will act merely as inert bypass resistances which will entail the application of larger currents in order to stimulate the normal fibres. Even when using currents of sufficient intensity to provoke a response in the denervated fibres, their action will be masked by the dominant action of the normal fibres. Despite this, presence of small numbers of denervated fibres may, under favorable conditions, be

revealed by the expedient of applying the electrodes over both ends of the muscle, so that the current field invests the whole muscle. This longitudinal position of the electrodes favors the direct stimulation of muscle fibres as distinct from indirect stimulation through the nerve with a single electrode applied over the motor point. Only when the longitudinal reaction is sluggish can it be regarded as significant of the presence of denervated fibres.

In Fig. 2 (C) the number of denervated fibres is greater and that of

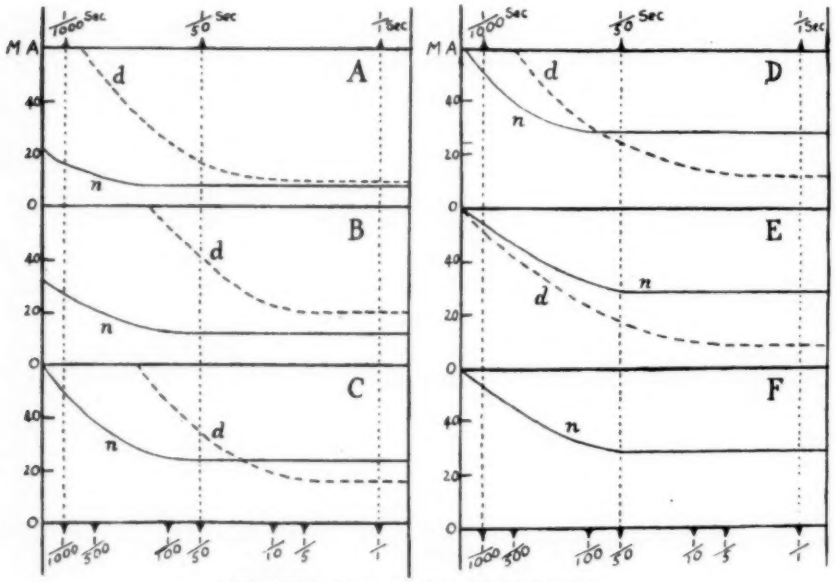

Fig. 2. — I/T curves of muscles corresponding to nerve lesions of varying extents.

normal fibres proportionately smaller. As a result, the I/T curves cross, which means that with the longer durations the typical sluggish response of the denervated fibres will be in evidence, whereas the brisk response which characterizes the normal fibres will be elicited with the brief impulses.

Fig. 2 (D) merely shows I/T curves of a muscle with a still greater proportion of denervated fibres. It should be noted that this has led to a shift towards the shorter durations of the point at which the curves cross. This is manifested by a prevalence of sluggish reactions over a larger range of impulses of long duration.

In Fig. 2 (E) the I/T curve of the denervated muscle fibres has, for all durations, a threshold well below that of the normal fibres. This implies that by stimulation over the muscle itself, no normal fibres can be detected although they might be revealed when the actual nerve is stimulated.

Fig. 2 (F) shows the I/T curve with the features of normal fibres only, but with a high threshold value for all durations. This might occur in the presence of oedema when currents of high intensity are required, or in the same muscle as the preceding one—Fig. 2 (E)—if no recovery of the denervated fibres had taken place and all these had now undergone complete fibrosis.

These various curves are of some interest when examined in conjunction with the method adopted for producing the reaction. It is evident that if they could be reconstituted in their entirety, as shown, they would afford valuable information from a diagnostic if not from a prognostic point of view. Unfortunately, of the twofold curves—the most important ones—only the

portions nearest the abscissa are obtainable by straightforward methods allowing of comparison. This reconstitution therefore becomes a problem with some of the characteristics of a cross-word puzzle. In both cases, a wealth of clues facilitates solution and avoids errors, while a paucity of knowledge of the subject under review is a disadvantage.

Technical Aspects of Muscle Testing

In Great Britain, scant attention has been paid to the technical aspects of muscle testing. Some adventurous individuals who were attracted by the promise of greater prophetic virtues were frequently let down through placing undue reliance in the more accurate methods of which they ignored the pitfalls. It is not surprising that many reverted to the faradic and galvanic tests.

There is a great deal to be said in favor of the classical method. It has the advantages of simplicity and it has no pretentions to precision. If its modest claims are analyzed, however, in the light of the curves of Fig. 2 its limitations become manifest. First of all, the term, faradic current, is one which lacks definition and uniformity. No two currents of that denomination can boast to being alike. Some consist of repeated trains of damped oscillations, more or less sustained; other consist of intermittent asymetrically alternating impulses. The coils which produce these currents also differ widely as regards frequency, output and impedance. All these factors would have to be standardized if the responses to faradic stimuli were quantitatively estimated, but this is not so. Their presence or absence is the only index of interest to the devotee of the classical method.

The duration of the faradic impulse is generally alleged to be and taught to be of the order of the thousandth of a second. In fact, it ranges from 1/800 second to 1/4,000 second. Again, coils may widely vary in the wave form and frequency of their output under different conditions. Be that as it may, we see from the curves in Fig. 2 (A) that impulses of this order of duration, unless they are of very high intensity, will fail to produce a reaction in a denervated muscle with a typical I/T d-curve but that a response will easily be obtained in the case of a muscle with the normal I/T n-curve.

The objections one can level against the use of interrupted galvanic currents controlled by means of a low resistance potentiometer are due to the fact that the current tends to fluctuate during its passage through the tissues. This is due to the progressive decrease in resistance of the superficial layers of the skin during the passage of current. This nuisance can be minimized by previous soaking of the skin and by introducing resistances of moderately high value in series with the electrodes, to render the variations in the load resistance negligible. In the case of Fig. 2 (B) the presence of the small number of denervated fibres will once more remain unrecognized unless special expedients are resorted to. In the case of Fig. 2(C) it is problematical whether the normal fibres will be detected by the faradic current. Whether it does or not will be decided by the total output of the coil and by its internal impedance. The overaction of surrounding muscles and the patient's inability to tolerate the current necessary to produce the reaction frequently act as factors curtailing the information which otherwise might be gathered. The same remarks hold in the case of Fig. 2 (D), except that the reactions to the galvanic stimulus are obtained with lower intensities. In the case of Fig. 2 (E), the threshold of the denervated fibres to the galvanic stimulus is lower still, and it is conceivable that with a faradic stimulus of very high intensity a reaction could be obtained in both the denervated and normal fibres. No comments are required in the case of Fig. 2 (F) since

the curve here denotes normal muscle fibres only. The muscle would respond to galvanic current of high intensity and might or might not respond to faradic stimulation.

Use of Special Apparatus

In an attempt to accumulate as much data as possible from which to reconstitute these curves, I devised an apparatus which gives out single impulses, rectangular in wave form and of which the duration and intensity could be independently controlled. By using pentode valves in the output circuit it was found possible to measure the current delivered and to ensure that this remained unaffected, within reasonable limits, by fluctuations of resistance. After a large number of experiments which involved the plotting of complete I/T curves of both normal and denervated muscles, it was decided for practical purposes to restrict the measurements of thresholds to three different durations. Durations of one second, a thousandth of a second, and an intermediate one of a fiftieth of a second were decided upon. The reasons for selecting these particular values were as follows. The one second value gave the investigator all the information which interrupted galvanism affords and was of sufficient length for the estimation of the rheobase. The thousandth of a second value was not chosen solely as a concession to the classical method. It was found from experimental work that in normal muscles the threshold for this impulse rarely exceeded double the rheobase, as can be seen from the n-curve in Fig. 2 (A). When expedient for diplomatic reasons this impulse of a thousandth of a second can moreover be identified with the traditional faradic impulse, with the added advantage that it can be assessed in milliamperes. The function of the intermediate duration of a fiftieth of a second is not immediately apparent. To envisage its utility it is necessary to realize that in the normal muscle the threshold for this intermediate impulse is still the same as the rheobase, but that for the denervated muscle the threshold for this intermediate impulse is more often than not at least double the rheobase. This can be seen from the curve in Fig. 2 (A). Again if the response it elicits is definitely recognized as brisk or sluggish, one is able to decide on which side of this duration the curves cross. If they cross as in Fig. 2 (C), the response at a fiftieth of a second should be brisk and as might be expected it should be found that the threshold for a thousandth of a second is less than double the threshold at a fiftieth of a second. The reason for this is apparent from the curves in Fig. 2 (C). When the curves cross as in Fig. 2 (D), the reaction to a fiftieth of a second should be sluggish and the response to a thousandth of a second should be well over twice the threshold at a fiftieth of a second.

Essentials of Muscle Testing

It will be seen from the foregoing considerations that muscle testing is not a mere mechanical amassing of observations as it is only too often represented to be. In addition to the apparatus required for producing and measuring stimuli needed to elicit responses in muscles, certain personal qualities are required of the operator. Of these, patience and an impelling desire to solve a problem from such clues as are available are not the least important. A most helpful attribute is a faculty to elaborate from the evidence obtained the more concrete details to fit into and complete the picture which the neurologist is trying to create. At times the details proffered threaten to spoil the whole pattern by being at variance with other evidence or accepted views. They may be deemed unacceptable. A good example

of this type of conflict is the coexistence of lack of voluntary power and good nerve conduction, as evidenced by a powerful reaction in muscles when the appropriate nerve is stimulated above the site of the lesion. Whether this can be fully explained on psychological lines is debatable. My own view is that more attention should be paid to the effect of injury on the part played by the afferent ingredient of the nerve through which the patient is made conscious of the existence of his muscles. A partial answer to this paradox may well lie in this direction.

Risks of misinterpretation due to anomalous innervation are minimized if the possible alternative nerve is stimulated when suspicion is aroused. Cross innervation is so prevalent in the hand that the effects of stimulating both the ulnar and the median nerve at the level of the wrist should be investigated as a matter of routine.

Anomalies of Muscle Testing

Electrically speaking, the two bugbears of transcutaneous electrical stimulation of muscles and nerves are (1) high resistances in series, and (2) low resistances in parallel, with the excitable tissue to be stimulated. The first of these acts as an impediment to the passage of the current and therefore

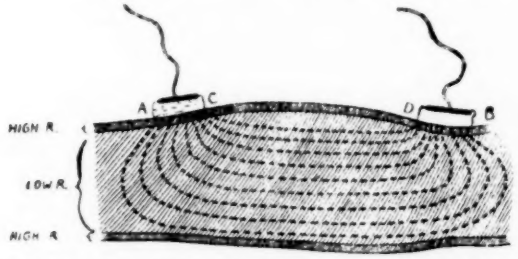

Fig. 3. — Spread of electric field in low resistance tissues when circuit incorporates zones of high resistance.

demands the application of high E.M.Fs; the second acts as a bypass and compels one to employ large currents.

When two small moist electrodes are applied to a limb the current has to pass through the stratum corneum of the skin and some subcutaneous fat. These are conductors of relatively high resistance and must be regarded as in series inasmuch as there is no alternative path for the current. Their presence results in a considerable spread of the current in the deeper tissues of low resistance.

If Fig. 3 be studied it will be seen that every line of force passes first through the tissues of high resistance and then through those of low resistance. With such an arrangement it is obvious that the total resistance along the path A-B, although longer in the low resistance portion, is but negligibly greater than along the shorter path C-D. In the deeper tissues the current density will be influenced to some extent by the presence of intermuscular fascial planes, blood vessels, bones and adipose layers, thus it may be assumed that in normal circumstances some portion of the field will have a higher density than another and that this core of high density will cause the electrode position to have some slight directional, and selective effect. The motor points of muscles must be explained in terms of areas on the skin which bring this core of high density into the most advantageous position for stimulating the nerve supplying the muscle. When a nerve has degenerated the motor point loses its significance and becomes less critical.

It is probable that anomalies of distribution account for some of the differences noted in connection with current threshold measurements in bulky and small muscles. In a large muscular mass in which the electric

field between the two electrodes is at liberty to expand it does not necessarily follow that the use of twice the total current causes a doubling of the original current density at all points throughout the muscle, as would be the case with small muscles, such as the interossei, which are situated between two bony structures of high resistance.

Of all the factors which hamper muscle testing, oedema holds pride of place. When present, the excessive intercellular fluids act as low resistance paths in parallel with the tissues to be stimulated. The application of Ohm's Law explains why a higher current has to be used in a low resistance in order to obtain the necessary potential differences along it.

A very marked increase in the blood content of muscle has a somewhat similar effect. I was able to demonstrate in a limb, which had a grossly

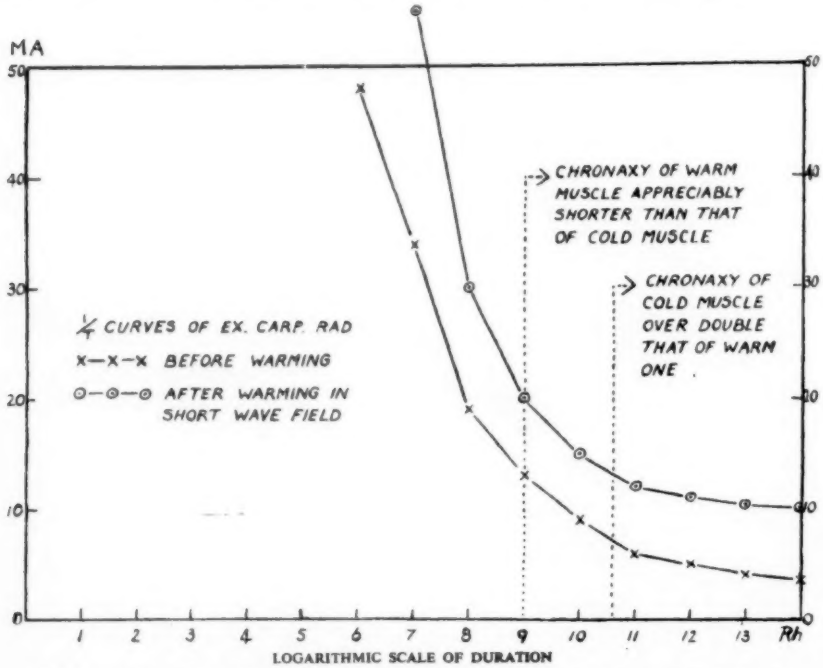

Fig. 4. — I/T curves showing apparent increase in excitability with rise in temperature. The greater chronaxy disproves this.

defective blood supply due to a brachial plexus lesion, that an increase in the circulation produced by raising its temperature in a short wave field, brought about an apparent decrease in the excitability—apparent, because an analysis of the I/T curves revealed that the chronaxy was considerably lower in the warm limb, although the threshold currents were higher, (Fig. 4).

It is unfortunate that when we explore nerves electrically we have to rely upon sight and touch in order to detect the responses. To be visible or palpable, a large number of fibres have to be brought into action. The number of fibres required will depend upon a number of factors of a mechanical order ranging from stiffness of various structures to tendon discontinuity.

In threshold measurements, in which minimal responses have to be observed, the tension on the structures concerned and hence the position of the limb, are of some importance. When concomitant contractions of other muscles due to spread of the stimulus occur, and provoke movements of tendons and of joints, the greatest caution has to be exercised in order that the investigator may avoid being misled. Cold, too, increases stiffness and slows

down contraction. It tends to cause a normal muscle to react sluggishly, at times simulating the typical reaction of a denervated muscle. Many problems would be solved if instead of having to detect muscle contractions we could detect action potentials.

Curiously enough, sensory losses which almost invariably accompany nerve lesions can be a source of error: The presence of anesthetic areas over the muscle to be tested enables one to use currents of much higher densities than would otherwise be tolerated by the patient. In consequence, a response to faradic stimulation is sometimes obtained in denervated muscles with a faradic current of unusually high intensity.

Some perplexing phenomena occasionally make their appearance. Of these, mention must be made of the sluggish contraction sometimes obtained as the result of faradic stimulation of the motor point or the nerve, of a muscle. My interpretation of this occurrence is that a few intact nerve fibres enable one to cause the contraction of the corresponding normal muscle fibres, whose movements act as a mechanical stimulus to the hyperexcitable denervated muscle fibres. It is significant that when this type of reaction is elicited, the muscles concerned are relatively easy to stimulate by percussion.

When a muscle is stimulated with threshold faradic and galvanic currents, it is occasionally observed that entirely different bundles of muscle fibres respond to these two stimuli. This is clearly significant of partial denervation.

Prognosis

From a single examination, it may be possible to endorse the neurological findings and thus to be of assistance in confirming the diagnosis. It may even happen that some unusual features of the case are brought to light, but a single examination is but rarely of prognostic value, unless it be found that all reactions conform with normality. At best, any venture as to prognosis belongs to the realm of speculation. A case which one day has all the appearances of a transient paralysis may well exhibit all the signs of complete denervation a month later.

Forecasting may be indulged in with greater confidence when the trend of developments, as disclosed by definite alterations in the condition relating to the response to electrical stimulation, point to recovery or deterioration. In regard to this check on progress, it would seem that the perversity of things has decreed that deterioration should be more susceptible of detection than improvement. The reasons for this are obvious. Degeneration takes place in the space of days whereas regeneration takes months. Furthermore, the processes involved in the former are better understood and more easily interpreted than in the latter. Indeed, little is known of the changes in the electrical characteristics of the motor unit from the moment when the regenerating axon reaches the neuromuscular junction until recovery is complete. The mystery surrounding the intricate biochemistry of this synapse during that critical phase is no better understood and the two processes are probably closely related. Before this ultimate stage is reached, that is during the static stage, it is possible to visualize a muscle consisting wholly or partly of the only two types of muscle fibre—normal and denervated. This simple conception unfortunately becomes one of great complexity at the moment when an increasing number of muscle fibres are regaining their nerve supply. Nor is this surprising, for it is inconceivable that a muscle fibre should affect the characteristics of a denervated fibre and an instant later, those of a normal fibre. There must be a transitional state with fluct-

uating characteristics; their I/T curves, of which we know little, probably are responsible for the confusion and erratic behavior encountered at this particular juncture.

Nerve Regeneration

A puzzling aspect of nerve regeneration is the frequency with which return of voluntary power precedes that of the response to faradic stimulation. Physiologists divorce the property of conduction and the property of excitability in nerves. It is not surprising therefore to find each returning separately. Excitability of nerves to electrical stimuli must be intimately connected with the integrity of the polarizable surface in the nerve fibre. Consequently it is not far fetched to postulate that nerve fibres and their sheaths regain the requisite electrical properties independently from axon regeneration.

Commentary

Most of those who have devoted some time to the problems appertaining to muscle testing have fallen into the error of focusing undue attention on one or another of its facets. Many have succumbed to the hope that the state of a muscle could be mathematically expressed and that the prognosis and rate of recovery could be deduced from this. Having myself fallen victim to this error, I hope by dint of a very chaotic picture to have shown the vanity of attempting to translate such a complex situation into simple terms. From this point of view electromyography certainly has the advantage over muscle stimulation. But even this method is not without its perplexities.

By way of bringing these confused images into perspective, I would like to stress the importance of carrying out as many of the tests as possible. No electrical examination is complete unless it consists of stimulation of the nerve trunk itself—preferably above the level of the lesion. This should be followed by faradic and galvanic stimulation of the motor points of different muscles supplied by the nerve. If the apparatus for doing so is available, the relative values of the threshold to both these stimuli should be estimated. The discriminating position of the electrode for faradic and galvanic stimuli should be noted as well as the character of the response elicited.

Finally, a condition of the nerve which satisfies all the data collected should be inferred.

I conclude in the hope that my insistance on the complexities of muscle testing will not be interpreted as a sign of a defeatist attitude but will stimulate interest in a broader aspect of the problem, and one which should prove of greater value to the cooperative neurologist. After all, one can well imagine a person describing the difficulties with which the solving of crossword puzzles bristles in a manner no less discouraging in appearance. Yet those puzzles can be solved and are solved.

I wish to record my indebtedness to the Medical Research Council for the grant which made possible the investigations relating to the I/T curves of which I have spoken.

References

Bauwens, P.: Brit. J. Phys. Med. N. S. **4**:150, 1941.

ARCHIVES of PHYSICAL THERAPY
OFFICIAL PUBLICATION AMERICAN CONGRESS OF PHYSICAL THERAPY

.·. EDITORIALS .·.

A MILLION DOLLARS TO PHYSICAL MEDICINE

Bernard Baruch's $1,100,000 donation for the advancement of Physical Medicine, announced in last month's ARCHIVES[1] as well as in thousands of newspapers in the United States, evoked a chorus of admiring comment for its motive as well as for its object. The motive: Tribute to the memory of his father, Dr. Simon Baruch, pioneer in the development of hydrotherapy in the United States. The object: To benefit the ill and the injured, especially those in the recent global warfare, by the well-founded employment of all methods of modern physical medicine. The specific dispositions of the Baruch gift to teaching and research centers were based on the recommendations of a committee appointed last October. This necessarily small committee labored for almost half a year to survey the problems and possibilities of physical medicine and consulted some 400 scientists in all fields of the healing art and research. The report on this survey[2] is an imposing and inspiring document and should serve as a beacon light to progress for many years to come. It is the result primarily of the earnest and self-sacrificing labor of our own Frank H. Krusen who acted as Director-Secretary of the Committee, and of the seasoned leadership of the distinguished educator, Ray Lyman Wilbur.

The creation of the Baruch Committee on Physical Medicine, the initial gift of $1,100,000 and the implied promise by Mr. Baruch of his entire fortune "if it works out all right," marks the most significant advancement in the forward march of physical medicine in the United States since the establishment of the Council on Physical Therapy by the American Medical Association in 1925. It is interesting to recall that although this Council was primarily intended to protect the medical profession against the abuses of advertising manufacturers of apparatus and only secondarily for the promotion of the safe and sane use of physical therapeutic measures, it soon became the leading factor in bringing about a widespread appreciation by the medical profession as to the value of physical therapy. While the Council repeatedly emphasized the need for more education and research in physical therapy, it could do comparatively little to promote these directly. The generous action of Mr. Baruch now enables a more active advance in this direction and its influence should be soon felt. At the same time the nation-wide publicity incidental to the Baruch gift has already brought evidences of greatly increased interest by the medical profession and by the public in physical medicine.

As we all look forward with sanguine expectations to a new era in the progress of physical therapy as part of the practice of medicine and to its greatly increased opportunities for restoring the sick and the injured, it seems fitting to pay tribute at this time to the handful of physical therapy pioneers in the United States who raised and steadfastly carried forward the flag of physical medicine under very adverse circumstances. They had no departments of physical therapy in hospitals in which to carry on clinical research, their technical equipment was comparatively primitive, and their

medical brethren looked on them with a mixture of suspicion and pity. Yet they had the vision and the foresight to carry on knowing that some day the medical profession would realize that physical measures deserve a large role in the diagnostic and therapeutic armamentarium of all physicians. This new era is breaking now, thanks to the well-guided impulse of the great philanthropist Bernard Baruch.

References

1. Baruch Committee of Physical Medicine, Arch. Phys. Therapy **25**:199 (March) 1944.
2. Report of the Baruch Committee on Physical Medicine, April, 1944.

AMERICAN HEALTH RESORTS

The series of articles[1-10] on health resorts published in recent months in the *Journal of the American Medical Association* under the auspices of the Committee on Health Resorts is evidence of a new interest taken by the medical profession in American spas and health resorts. It is a matter of common knowledge that for various reasons the medical and economic status of most American spas has for many years deteriorated rather than progressed, and as a further result, the attitude of the majority of American physicians towards the spas was that of total indifference. The first change in this attitude in recent years came when a group of members of the American Congress of Physical Therapy made two study trips to a number of eastern spas. Subsequently, at the 1937 Annual Session of the Congress a Committee on Spas and Health Resorts was appointed to survey the spa situation. This survey was reported on at the 1938 Annual Meeting,[11] and as a direct result of this report the American Medical Association itself appointed in 1939 a Committee on Health Resorts under the chairmanship of the late Dr. Bernard Fantus, who accompanied the original Congress Committee on one of its study trips. The untimely death of this great therapeutist was a great blow to the work of the new Committee. However, the series of articles referred to represents the results of a study extending over three years and portrays the complex aspects of health resort therapy very well. The present war situation in the meantime has brought some definite action through the taking over by the Army, Navy and Veterans Administration of a number of health resorts as part of the military rehabilitation program.[12] In some of these new health centers some interesting clinical research work is already being carried on, as shown by the paper by Drewyer and Hughes in this issue of the ARCHIVES.[13] It is most desirable that when Peace returns, American health resorts should play an important role in the modern American health system, serving large numbers of sufferers from chronic illness and helping to recondition many who are simply worn out and tired. There exists indeed a splendid opportunity for a long range constructive medical-social plan for the rehabilitation and best possible utilization of the unquestionable natural and other resources of American health resorts.

References

1. Mills, C. A.: Climate and Disease, J. A. M. A. **123**:551 (Oct. 30) 1943.
2. Jarman, M. B.: Importance of Rest, Exercise and Dietary Regulation in the Spa Regimen, J. A. M. A. **123**:631 (Nov. 6) 1943.

(Concluded on page 309)

MEDICAL NEWS

Announce Permanent Baruch Committees on Physical Medicine

The following communication has been received from Dr. Frank H. Krusen . . .:

In October, 1943, Mr. Bernard M. Baruch appointed a committee under the chairmanship of Dr. Ray Lyman Wilbur, Chancellor of Stanford University, to make a survey of the needs for development of teaching and research in physical medicine on a national scale. It was requested that this committee give special attention to the relationship of physical medicine to the rehabilitation of casualties of war. This committee completed its survey and made its final report on Thursday, April 27th, and has ceased to function. Mr. Baruch has given an initial sum of $1,100,000 to inaugurate the program which was suggested by the survey committee.

In order further to activate this program, Mr. Baruch has established an Administrative Board with Dr. Ray Lyman Wilbur as Chairman, Dr. Frank H. Krusen as Director, and with the affiliation of Miss Mary A. Boyle, a long time associate of Mr. Baruch. Offices have been established at 597 Madison Avenue, Room 3600, New York 22, N. Y., which are in charge of Miss Grace Keefe as Executive Secretary. Dr. Ernest J. Jaqua, former President of Scripps College and a former member of the Professional and Technical Training Division of the Bureau of Training of the War Manpower Commission, has been appointed as Chief Educational Adviser, and it is now proposed to establish two permanent committees: (1) a Scientific Advisory Committee and (2) a Committee on Physical Rehabilitation and Reconditioning. Our Chairman, Dr. Wilbur, has selected the personnel and officers for these two committees. They are as follows:

Scientific Advisory Committee—Chairman and Director—Dr. Frank H. Krusen, University of Minnesota, Physical Medicine.

Secretary and Chief Educational Adviser—Dr. Ernest J. Jaqua, Baruch Committee, General Education.

Dr. John Stanley Coulter, Northwestern University, Physical Medicine.

Dr. Charles Gordon Heyd, Columbia University, Surgery and Medical Education.

Dr. A. C. Ivy, Northwestern University, Physiology.

Dr. C. D. Leake, University of Texas, Medical Education.

Dr. Frank Ober, Harvard University, Orthopedics and Graduate Medical Education.

Dr. Winfred Overholser, St. Elizabeths Hospital, Neuropsychiatry and Occupational Therapy.

Dr. Francis O. Schmitt, Massachusetts Institute of Technology, Biophysics.

Dr. Ray Lyman Wilbur, ex-officio.

Committee on Physical Rehabilitation and Reconditioning—Chairman and Director—Dr. Frank H. Krusen, Rehabilitation and Physical Medicine, Civilian.

Secretary and Chief Educational Adviser—Dr. Ernest J. Jaqua, Rehabilitation and Vocational Counseling, Civilian.

Major Walter Barton, Reconditioning and Rehabilitation, Army.

Capt. Charles F. Behrens, Radiology and Physical Medicine, Navy.

Dr. Dean A. Clark (Senior Surgeon, Retired), Vocational Rehabilitation, Federal Security Agency.

Dr. Charles Griffith, Medical Rehabilitation, Veterans Administration.

Capt. Howard Montgomery, Rehabilitation, Navy.

Lt. Col. Howard A. Rusk, Convalescence and Rehabilitation, Army Air Corps.

Mr. H. V. Stirling, Vocational Rehabilitation, Veterans Administration.

Lt. Col. Benjamin A. Strickland, Jr., Physical Medicine, Army.

Col. Augustus Thorndike, Reconditioning and Rehabilitation, Army.

Dr. William S. Tillett, Convalescence and Rehabilitation, National Research Council.

It is sincerely believed that we will have a truly magnificent opportunity to contribute to the advancement of medicine in general and to physical medicine in particular.

You will receive the final revised report of the Baruch Survey Committee on Physical Medicine when it is published.

Comments Concerning the Report of the Baruch Committee on Physical Medicine

Ross T. McIntire, Vice-Admiral Medical Corps, U. S. N., Surgeon General of the Navy.

"I am glad to tell you the Medical Department of the Navy is in complete accord with the principle and recommendation laid down in your report to Mr. Baruch.

The establishment of certain post-graduate teaching centers is highly desirable. Physical medicine has not been stressed enough in medical education in this country.

I can assure you the Bureau of Medicine and Surgery will give every assistance possible in the successful carrying out of your program."

Norman T. Kirk, Major General, U. S. Army, The Surgeon General.

"Preliminary word of your gift of over one million dollars for the scientific development of physical medicine, with special reference to its

application in the treatment of war and post-war casualties, has just been announced. The Medical Department of the Army is vitally concerned with any new scientific enlightenment in this field, especially as it pertains to reconditioning of wounded soldiers and sailors.

You are to be highly commended for the inauguration of a much needed scientific approach to the physical aids to medicine and especially its bearing on the program of restoration of function and salvage of manpower."

Frank T. Hines, Administrator, Veterans Administration.

"I had a chance to talk with Dr. Ray Lyman Wilbur and his associate, and I think you are to be congratulated upon your generosity of spirit in promoting the project which Dr. Wilbur contemplates developing through your help.

I have told Dr. Wilbur that, in my judgment, a splendid opportunity for public service exists in the field contemplated, and that I will give it my full cooperation and whatever help I can to make it a success."

David N. W. Grant, Major General, U. S. A., The Air Surgeon.

"I have just seen the very excellent report of the Baruch Committee on Physical Medicine and have learned of Mr. Baruch's plans to establish a fund to further research and teaching in the field of Physical Medicine.

In the past year and a half, through our experience with the Convalescent Training Program in the Army Air Forces we have learned a great deal more about the tremendous field of Physical Medicine and see the great need for further research. There is a shortage of trained personnel in this entire field and as our needs increase, this shortage must necessarily become proportionately larger.

There is an especial need in the Army Air Forces for both diagnostic and therapeutic research in both the clinical and scientific aspects of Physical Medicine as it pertains to problems peculiar to Aviation Medicine. Frostbite, high altitude physiology, denitrogenization and aeroembolism are typical examples of the problems ripe for further study. Close cooperation between civilian investigators and the Army Air Forces Medical Service must be maintained to achieve maximum results.

Mr. Baruch and your committee have rendered an invaluable service, and now with the establishment of a permanent committee and the splendid endowment fund, the work in this field is bound to be greatly accelerated and should make valuable contribution both to military and civilian medicine."

"Physical Medicine. Dr. Foster presented the recommendation of the Bay County Medical Society that the Executive Committee of The Council urge the Michigan medical schools to offer more training in Physical Medicine, as well as the recommendation to the M. S. M. S. Committee on Postgraduate Medical Education that it include lectures on Physical Medicine in the M. S. M. S. postgraduate extra-mural courses. Motion of Drs. Foster-Sladek that the Executive Committee communicate with the Deans of the two medical schools in Michigan urging them to stress the importance of Physical Medicine in their curricula and also to suggest to the State Board of Registration in Medicine that they likewise write the Deans of the medical schools on this subject; and further that the Committee on Postgraduate Medical Education be requested to include Physical Medicine in its courses for the physicians of Michigan; carried unanimously."—From Minutes of the Meeting of the Executive Committee of The Council, February 24, 1944.

Session on Physical Therapy, The Medical Society State of New York

On Tuesday morning, May 9, the session on physical therapy will be held jointly with the section on pediatrics of the Medical Society of the State of New York.

With Drs. Kristian G. Hansson of New York and Walter S. McClellan of Saratoga Springs presiding the following program will be presented:

Edward L. Compere, M.D., Chicago (by invitation): The Poliomyelitis Epidemic in Chicago in 1943. Discussion: Philip M. Stimson, M.D., New York and William Bierman, M.D., New York.

Royal Storrs Haynes, M.D., New York: Good Posture in Children. Discussion: John R. Cobb, M.D., New York and William B. Snow, M.D., New York.

Veronica O'Brien, M.D., New York: Treatment of Children with Cerebral Palsy. Discussion: Arno D. Gurewitsch, M.D., New York.

Hans J. Behrend, M.D., New York: The Role of Hydrotherapy in Rehabilitation. Discussion: Walter S. McClellan, M.D., Saratoga Springs and Robert Muller, M.D., New York.

Physical Therapy Technicians in the Armed Forces

Word has just been received indicating from the latest information available that the Army needs approximately 200 physical therapy aides in addition to those they already have in service, and in training in army or civilian schools.

It has been learned that the Navy Medical Department needs approximately 75 physical therapy aides or technicians in addition to those they already have in the service. Women, who are qualified physical therapy technicians, may make application to the nearest Navy Recruiting Station or Office of Naval Officer Procurement for appointment in the WAVES. Qualified physical therapy aides, who are also graduate female nurses, may request application forms and other information concerning appointments in the Navy Nurse Corps from the Superintendent, Navy Nurse Corps, Bureau of Medicine and Surgery, Navy Department, Washington 25, D.C.

Program, Twenty-third Annual Conference, American Physiotherapy Association, Held at Pennsylvania Hotel, New York City, May 17-21, 1944

Wednesday, May 17, 9-12 A. M. — Physical Therapy School Section.

Discussion of common problems relating to physical therapy schools and recommendations for further study in the solution of the existing problems.

Chairman: Miss Gertrude Beard, Northwestern University Medical School, Chicago, Illinois.

Discussion leaders:

Miss Helen Kaiser, Technical Director, Course for Physical Therapy Technicians, Duke Hospital, Durham, North Carolina.

Miss Josephine Rathbone, Technical Director, School for Physical Therapy Technicians, Columbia University, New York City.

Miss Constance K. Greene, Technical Director, School for Physical Therapy, Bouve-Boston School of Physical Education, Boston, Massachusetts.

Major Emma E. Vogel, P. T. A., A. U. S., Director, Physical Therapy Aides, Surgeon General's Office, Washington, D. C.

Miss Catherine Worthingham, Technical Director, School for Physical Therapy Technicians, Stanford University, California.

Miss Mary E. Nesbitt, Chairman, Educational Committee, American Physiotherapy Association, Massachusetts General Hospital, Boston, Massachusetts.

Thursday, May 18, 9-12 A. M.—Chapter Problems Section. Chairman: Mrs. Margery Wagner, National Chapter Relations Chairman.

12-2 P. M.—Crippled Children's School Section Luncheon. Chairman: Miss Marjorie Sheldon, Branch-Brooks School for Crippled Children, Newark, New Jersey.

2-5 P. M.—Infantile Paralysis Round Table.

A discussion of recent developments in the treatment of infantile paralysis with emphasis upon reports from those who have been associated with the work in the 1943 epidemic areas. Problems that have arisen (including equipment) recording and teaching will be considered.

Chairman: Lucille Daniels, Assistant Professor, Division of Physical Therapy, Stanford University, California.

"The Incidence of Infantile Paralysis in 1943," by Don W. Gudakunst, M.D., Medical Director, National Foundation for Infantile Paralysis.

"A Recent Tour Through 1943 Infantile Paralysis Areas," by Jessie L. Stevenson, Joint Orthopedic Nursing Advisory Service, New York City.

Discussants:

Charlotte Anderson, James Whitcomb Riley Hospital, Indianapolis, Indiana.

Jean L. Collings, Portland, Oregon.

Carolynn A. Davis, Visiting Nurse Association, Chicago, Illinois.

Mary Deatherage, Children's Hospital, Akron, Ohio.

Mildred Elson, Northwestern University Medical School, Chicago, Illinois.

Lela Ewert, Children's Hospital, San Francisco, California.

Dorothy Fredrickson, Children's Hospital, Boston, Massachusetts.

Janet Merrill, Children's Hospital, Boston, Massachusetts.

Alice Lou Plastridge, Georgia Warm Springs Foundation, Warm Springs, Georgia.

Susan G. Roen, Orthopaedic Hospital, Los Angeles, California.

Louise Suchomel, Visiting Nurse Association, Detroit, Michigan.

Beatrice Vlahos, National Foundation for Infantile Paralysis, New York City.

Jessie Wright, M.D., D. T. Watson School of Physical Therapy, Leetsdale, Pennsylvania.

Friday Evening, May 19 — Informal dinner, Pennsylvania Hotel.

Host: New York Chapter. Toastmaster: A. Garman Dingwall, President, New York Chapter. Speakers: Frank H. Krusen, M.D., Associate Professor of Physical Medicine, the Mayo Clinic; Don W. Gudakunst, M.D., Medical Director, The National Foundation for Infantile Paralysis.

Saturday, May 20, 12-2 P. M.—Public Health Luncheon. Chairman: Miss Jessie Stevenson.

Program on Rehabilitation—Chairman: Hazel E. Furscott.

Friday, May 19—Analysis of Existing Plans—9 to 12 A. M.—The American Plan. Chairman: Hazel E. Furscott.

The Army Air Forces—Lieutenant Colonel Howard A. Rusk.

The Army—Colonel Augustus Thorndike.

The Navy—Commander R. Bruno Arnold.

The Veterans' Facilities—Miss Alice Baker.

The Federal Security—Federal Program—Mr. Michael J. Shortley; Regional and State—Miss Tracy Copp.

The Industrial Program—Mr. Stanwood L. Hanson.

2 to 5 P. M.—The American Plan (continued) and Foreign Plans. Chairman: Jessie L. Stevenson.

Crippled Children's Program—Dr. A. L. Van Horn.

The National Council on Rehabilitation — Colonel John N. Smith, Jr.

State Councils of Rehabilitation — Miss Bell Greve.

Rehabilitation Legislation — Colonel John N. Smith, Jr.

Compensation Laws—Mr. Harry Howett, Mr. W. H. Seymour.

The English Plan—Colonel F. S. Gillespie.

The Russian Plan—Miss Helen Kaiser.

The German Plan—Miss Mildred Elson.

Saturday, May 20—Panel Discussion—9 to 12 A. M.—Chairman: Dr. Don G. Gudakunst. I. Stages of Rehabilitation.

1. Diagnosis, medical and surgical treatment.
2. Before medical and surgical treatment.
3. Immediately after medical and surgical treatment.
4. Convalescence.
5. Vocational training.

II. The Use of the Various Facilities in All Stages of Rehabilitation. Key speakers: Dr. Dean A. Clark; Colonel Leonard T. Peterson.

1. Facilities used in various stages of rehabilitation.

a. Surgery, psychiatry, and medicine—Dr. K. G. Hansson, Colonel Leonard T. Peterson.

b. Physical therapy—Major Emma E. Vogel, Mr. Paul Campbell, Lieutenant (j.g.) Dorothy Lovedahl.

c. Occupational therapy—Mrs. Winifred C. Kahmann, Mrs. John A. Greene, Miss Elizabeth Martin.

d. Curative workshop — Miss Mary Castle, Miss Lucille Daniels.

e. Sheltered workshop—Mr. Oliver A. Friedman, Colonel John N. Smith, Jr.

f. Recreational therapy — Miss Mary Castle, Mrs. John A. Greene, Mrs. Winifred C. Kahmann.

g. Vocational therapy and training—Lieutenant Colonel Howard A. Rusk.

2 to 5 P. M.—Panel Discussion—Chairman: Catherine Worthingham. I. Integration of the Use of All Facilities in the Various Stages.

Key speakers: Mr. Basil O'Connor, Miss Bell Greve and Dr. Frank H. Krusen.

Discussants: Commander H. Bruno Arnold, Lieutenant (j.g.) Signe Brunnstrom, Colonel F. S. Gillespie, Lieutenant Colonel Howard A. Rusk, Mr. W. H. Seymour and Mr. Michael J. Shortley.

A Letter From England

The following excerpt from a letter by Dr. D. Hay Scott, Editor of *The British Journal of Physical Medicine and Industrial Hygiene,* recently addressed to one of our editors should be of timely interest.

I am making the acquaintance of dozens of American soldiers these days, talking with them, discussing various points about living conditions and so on, getting to know them, and I hope they are getting to know me. We are all agreed that there is very strong similarity between the average American and the average Britisher; this is a point which is very little referred to in the newspapers. For this reason we find that the Americans are settling down very quickly and very satisfactorily. And I would like to add this: the discipline is excellent; they are fine fellows every one of them and they are worthy ambassadors of the United States of America. The only thing we are worried about here is that we cannot offer them the same amount of hospitality as we have been accustomed to do. For instance, we are rationed down to the last ounce in essential foods, our supply of beverages is very much limited, and coal for the fires is delivered in spoonfuls rather than in tons. All the same we have a great desire to welcome these men right into our homes. We feel we want them there, and that is the best way I can put it in order to illustrate the reaction that they have caused hereabout.

Dr. Watkins Lectures on Physical Therapy

On April 20 at the U. S. Naval Hospital, Newport, R. I., Dr. Arthur L. Watkins gave a clinic and lecture on Physical Medicine. This talk was a part of the War Time Postgraduate Medical Meetings.

Lieut. Comdr. Newman to Seattle

Word has been received that Lieut. Comdr. Louis B. Newman has been transferred to the U. S. Naval Hospital at Seattle.

Father Schwitalla Guest Speaker

The Joint Council of Pathologists, radiologists, anaesthesiologists and physical therapy physicians held a dinner May 4th in the Hotel Commodore at which Father Schwitalla was the guest speaker. His subject was "General Service Aspects of Medical Practice in Hospitals."

Father Schwitalla's lucid analysis of the problems confronting the hospitals and the physicians who practice in them has received widespread appreciation.

Grant to Stanford

Realizing the acute need for physical therapy personnel, partly resulting from the war, The National Foundation for Infantile Paralysis has just made a two-year grant totaling $34,080 to the Stanford University School of Health (Women) at Stanford University, California, it was announced today by Basil O'Connor, President of the National Foundation.

This grant, which is in addition to other funds given by the National Foundation to this University, is for the two-fold purpose of strengthening the physical therapy technicians' school and of preparing syllabi and text materials for the use of physical therapy instructors and their students.

Under this program selected students will be provided specialized training designed to prepare them to become skilled teachers of physical therapy.

"The 1943 epidemic of infantile paralysis emphasized the serious lack of physical therapy technicians and qualified teachers," Mr. O'Connor said. "It would seem that the success of any attempt to develop a satisfactory corps of technicians in the United States would depend to a considerable extent on having adequately trained instructors engaged in teaching this subject, and suitable text materials."

Drs. Arana and Rodriguez, Honored at Dinner

Dr. Salvador Soto Arana, San Juan, Puerto Rico and Dr. Daniel Rodriguez, of Cali, Columbia were honored at dinner at the Union League Club, Chicago, April 20, 1944. Other guests were Dr. John S. Coulter, Hon. Luis E. Despradel, Consul, Dominican Republic, Mr. Bryan H. Doble, Hon. Carlos A. Gerlein, Consul, Colombia, Mr. H. J. Holmquest, Dr. Clarence A. Neymann, Dr. S. L. Osborne and Dr. Milton G. Schmitt.

National Council on Rehabilitation

At the 1943 Annual Meeting of the National Council on Rehabilitation the Executive Committee was directed to make a study of workmen's compensation legislation and bring a report to the meeting in 1944. This meeting will be held in the Ritz-Carlton Hotel New York City, on June 5 and 6.

Proposed Legislation for Physical Therapy Personnel

H. R. 4445, introduced by Representative Bolton, Ohio, proposes to authorize temporary appointment as officers in the Army of the United States of members of the Army Nurse Corps, female persons having the necessary qualifications for appointment in such corps, female dietetic and physical therapy personnel of the Medical Department of the Army, exclusive of students and apprentices, and female persons having the necessary qualifications for appointment in such department as female dietetic or physical therapy personnel.

Statement of Policy

The following "correction" appeared as an editorial in the February 19, 1944, issue of the *Journal of the Medical Society of the County of New York.*

In the January 8th issue of the *Journal* there appeared an editorial entitled "Realistic Approach." This editorial has been variously interpreted as the expressed policy of the Medical Society of the County of New York on the "all-inclusive contract" of the Associated Hospital Service of New York, whereas its intent was comment on the progress report of the Special Committee of the Comitia Minora which has been investigating and studying this contract.

The policy of the Society was established by the Comitia Minora at its meeting on October 11, 1943, and subsequently confirmed at the Stated Meeting on October 25th, when it approved the recommendation of the Committee on Public Relations, namely: "Resolved that the Medical Society of the County of New York heartily endorse the recommendations of the House of Delegates of the American Medical Association as published in the July 31st issue of the *Journal of the American Medical Association* regarding the all-inclusive plan of the Associated Hospital Service."

That there may be no misunderstanding on the part of any of the members, we would repeat that the Medical Society of the County of New York is opposed to the inclusion of any form of medical practice, including pathology, radiology, anesthesiology and physical therapy, in any hospital service contract. This policy is in harmony and agreement with the published principles of the Medical Society of the State of New York.

Annual Report of Georgia Warm Springs

The Annual Report of the Georgia Warm Springs Foundation for the fiscal year ended September 30, 1943, reveals that during the year 541 patients from thirty-seven states in the country received treatment, and of that number, 346 patients (or 64 per cent) received financial assistance. These aid patients received 25,038 hospital days' care, or 79.16 per cent of the total 31,628 days' hospital care given all patients.

Of the 541 patients in residence during the year, 261—or nearly half—were in the age group of 10 through 19 years. Of the remainder, 155 patients ranged from 20 through 38 years; 105 were under 10 years, and 19 were over 39 years of age.

The financial statement discloses that grants received from The National Foundation for Infantile Paralysis, Inc., were: $225,000 for general purposes, for the year beginning October 1, 1943, and $43,480 for educational purposes for the year beginning July 1, 1943. Revenue from patients and other activities at Warm Springs, plus donations and bequests totaled $234,123.36. Excess of expenses over revenue, exclusive of grants, for the year ended September 30, 1943, was $164,146.02.

Organizd in 1927 under the guidance of President Roosevelt, the Georgia Warm Springs Foundation is a non-stock, non-profit organization, developed for the two-fold purpose of using the natural facilities at Warm Springs and the skill of a carefully selected professional staff for direct aid to patients; and secondly, to pass on to hospitals and the medical profession any observations or methods of proven merit resulting from research which might be suitable for practical application elsewhere.

No distinction is made in the care or housing of patients, whether they pay their own expenses or receive full or part financial aid, and the particular classification of each is known only to the officers in charge of financial arrangements at the institution. No profit is derived from any patient.

Government Hospitals Need Occupational Therapists

While on battlefronts scattered throughout the world our armed forces are concentrating on winning the war, in Army and Veterans' hospitals here in the United States, trained occupational therapists are among those bending their efforts toward winning the peace.

These therapists are erasing the ravages of war by the systematic rehabilitation of injured bodies and minds. Some of the war-wounded are reconditioned for further service in the Army; others are fitted for useful civilian work in a normal environment.

As increasing numbers of injured soldiers return to the hospitals, more and more occupational therapists are needed to aid in their adjustment to normal life. In greatest demand are experienced graduates of accredited occupational therapy schools. Experience should be in hospitals acceptable to the American Medical Association. For some positions, however, college training in psychology and in arts and crafts or trades and industries, or experience as a junior aide in Veterans' hospitals, may be substituted for training in occupational therapy schools. Other positions will be filled by inexperienced graduates of occupational therapy schools.

The salary range of these positions is $1,970 to $2,433 a year, including overtime pay. Those appointed at $1,970 will be trainees for a period of 18 months; those appointed at $2,190 and $2,433 will administer occupational therapy under medical and general supervision, in Army and Veterans' hospitals.

There are no age limits and no written tests, but applicants must be physically capable of performing the duties involved. Persons now using their highest skills in war work should not apply. Federal appointments are made in accordance with War Manpower Commission policies and employment stabilization programs.

Further information on Occupational Therapy Aide positions and forms for applying can be obtained from first- and second-class post offices or from the United States Civil Service Commission, Washington 25, D. C.

Dr. Trask to Receive Posthumous Honor

Dr. James D. Trask, one of America's most famous fighters in the war against infantile paralysis, will be posthumously honored early next month when a Liberty ship named in his honor is launched at the Bethlehem-Fairfield shipyards in Baltimore.

As a salute to the late scientist and his colleagues who are carrying on polio research work through grants from The National Foundation for Infantile Paralysis in colleges, universities and laboratories throughout the country, the National Foundation suggested the naming of the ship in honor of Dr. Trask. The ship will be christened by his widow, with prominent scientists from Yale University and Johns Hopkins present at the launching ceremonies.

Dr. Trask, who died in Chicago on May 24, 1942, while working for an Army Medical Commission under an appointment as consultant to the Secretary of War, became internationally known for his work in infantile paralysis, a large part of it done with his close associate, Dr. John R. Paul of Yale University. The two men, who helped found the Yale Poliomyelitis Commission in 1931 after an epidemic of infantile paralysis swept Connecticut, made an outstanding team in the study of the disease.

In recognition of their work, Drs. Trask and Paul received the first grant made by the Committee on Virus Research of the National Foundation after it was organized in 1938.

Together Drs. Trask and Paul published many papers on the disease and they were signally honored a month before Dr. Trask's death when they were awarded the John Phillips Memorial Medal at a meeting of the American College of Physicians.

Born in Astoria, N. Y., on August 21, 1890, Dr. Trask was graduated from the Cornell University Medical College and interned at Bellevue Hospital. A veteran of World War I, he served on the staff of the Rockefeller Institute for Medical Research, New York, from 1919 to 1921, when he joined the faculty of the Yale University School of Medicine as an instructor in medicine. In 1925 he was made an assistant professor of medicine and in 1927 an associate professor of pediatrics, retaining that position until his death. During the last month of his life he was working in Army posts in the Chicago area on problems of hemolytic streptococcus infection as a member of the Commission on Hemolytic Streptococcal Infections of the Board for the Investigation and Control of Influenza and Other Epidemic Diseases in the Army.

Besides being widely known as an investigator in the field of infantile paralysis, Dr. Trask was well known for his hobby—boating.

Extension of the Roehampton Artificial Limb Center

An extension of the Roehampton Limb Fitting Center was recently opened by the Chinese ambassador, Dr. Wellington Koo, who described the hospital as a fascinating and inspiring story of successful endeavor in a practically new field of service to humanity. It had restored to the injured, through the emphasis on their status as useful members of the community that sense of dignity and self-respect without which life became a burden, he stated. The new addition would be of special interest to the United Nations, he pointed out, as it made available to them the splendid facilities of the institution for making and fitting artificial limbs. The ambassador recognized that it was a gracious gesture for Great Britain to share with the Allies the knowledge, skill and experience acquired in thirty years of limb fitting.

BOOK REVIEWS

VASCULAR RESPONSES IN THE EXTREMITIES OF MAN IN HEALTH AND DISEASE. By *David I. Abramson,* Captain, Medical Corps, United States Army, Formerly Associate in Charge of Cardiovascular Research, May Institute for Medical Research of the Jewish Hospital, Cincinnati, Ohio. Cloth. Pp. 412. Price, $5.00. First Edition. Chicago: University of Chicago Committee on Publications in Biology and Medicine. University of Chicago Press, 1944.

This book gives a background for the approach to the problems of peripheral vascular diseases. The material consists principally of a thorough and well-organized review of the work that has been done in vascular physiology. The information presented is based primarily on studies made on human beings in the author's laboratories and elsewhere in this country. The author has gathered and correlated a large volume of widely distributed reports on the vascular system.

The book is divided into seven parts. In the first section, the anatomy and general physiology of the peripheral blood vessels are considered. In the second the various procedures developed for the qualitative and quantitative study of the peripheral circulation in man are given a critical appraisal. Each procedure is evaluated carefully; its technical and theoretical limitations as well as its possibilities are pointed out. In this section too the use of the oscillometer, cutaneous and deep temperature thermometers, capillary microscopes, the histamine flare test, circulation time, arteriography and venography, Stewart's calorimeter and the photo-electric plethysmograph as a means of determining the status of the peripheral circulation are considered briefly and the construction and use of the venous occlusion plethysmograph which the author has found most satisfactory in his own laboratory are described in detail. The author is most impressed by the results obtained by this apparatus and is critical of the results obtained by the other methods. However, in many of the more common conditions it can be seen that the gross quantitative results made by simpler and more available methods will give reliable and valuable information to the physician.

The third section includes a summary of the studies which demonstrated the responses of the blood vessels in the extremities to various types of physiologic conditions. This includes studies of the effects on the cardiovascular system of bodily position, environmental temperature, food, anoxia, menstruation, gestation and exercise.

Section four deals with the responses of the peripheral blood vessels to various hormones, the vasodilator drugs and vasoconstrictor substances. The fifth portion of the book deals with an analysis of the blood flow in the various systemic diseases including the metabolic abnormalities, diseases of the blood and cardiac disorders. The sixth part which seems much too short, includes a brief discussion of clinical aspects of the various peripheral vascular diseases with suggestions as to their treatment.

Part seven includes a critical study of the various methods used in treatment of peripheral vascular disease. One chapter deals with an evaluation of the mechanical procedures including passive vascular exercise treatment with apparatus for producing intermittent venous occlusion, the suction-pressure apparatus, the oscillating bed and the local and generalized application of heat. No definite conclusions are given regarding the advantages and disadvantages of these methods although the limitations of each method are carefully pointed out. The last section deals with the use of various vasodilating drugs in the treatment of peripheral vascular disease. A discussion of the results obtained by iontophoresis of vasodilating substances is included.

This book contains an excellent review of the literature on peripheral vascular diseases. A complete bibliography is included at the conclusion of each chapter. This book will prove valuable to those interested in a study of basic physiology involved in normal and abnormal peripheral vascular conditions. The clinician is given an excellent background for a more thorough understanding of peripheral vascular abnormalities and their management.

PHYSICAL FOUNDATIONS OF RADIOLOGY. By *Otto Glasser,* Ph.D., Professor of Biophysics and Head of Department of Biophysics, Cleveland Clinic Foundation, Cleveland; *Edith H. Quimby,* Sc.D., Associate Professor of Radiology (Physics), College of Physicians and Surgeons, Columbia University, N. Y.; *Lauriston S. Taylor,* Ph.D., Chief, X-Ray Section, National Bureau of Standards, Washington, D. C., and *J. L. Weatherwax, M.A.,* Philadelphia General Hospital and Graduate School of Medicine, University of Pennsylvania, Philadelphia. Cloth. Price, $5.00. Pp. 426. New York: Paul B. Hoeber, Inc., 1944.

This volume is a textbook written by eminent specialists in the field of radiology. The medical student planning to specialize in radiology will find that the facts, principles and laws of physics bearing on x-rays are presented in a manner suitable to his non-mathematical taste and that complicated formulas are not employed. The mathematical expressions used for the most part do not go beyond simple high school algebra. It is well written and covers the subject.

Opening with an historical outline giving dates of significant discoveries, Otto Glasser proceeds to give the modern conception of the fundamental concepts of matter and the nature of corpuscular and electromagnetic wave radiations. J. L. Weatherwax discusses the fundamentals of electricity and magnetism, and also most of the subjects dealing with engineering features of the apparatus. The measurements of quantity and quality of x-rays are handled by Lauriston S. Taylor, whose association with the National Bureau of Standards makes him ably qualified to write this part. Edith H. Quimby presents the medical approach as applied to radiology. The authors are to be congratulated for writing a textbook that has a physician's approach to physics and radiology rather than that of an engineer.

HEALTHFUL LIVING FOR NURSES. By *Harold S. Diehl*, M.A., M.D., Sc.D., Professor of Preventive Medicine and Dean of the Medical Sciences, University of Minnesota; Director, Health Studies, American Youth Commission; Member, National Advisory Health Council of the United States Public Health Service, and *Ruth E. Boynton*, M.S., M.D., Professor of Preventive Medicine and Public Health and Director of the Students' Health Service, University of Minnesota; Vice-President, Minnesota State Board of Health. First edition. Cloth. Price, $2.50. Pp. 534, with few illustrations and numerous graphs. New York and London: McGraw-Hill Book Company, Inc., 1944.

This volume is a valuable addition to the available literature on hygiene and the preservation of health.

The nurse, for whom the book is written, needs to exercise great care to keep herself fit. For her own sake as well as for the sake of those dependent on her service, she should thoroughly understand and intelligently follow an adequate program of health and medical care.

According to the authors such a program should include: (1) healthful living conditions, (2) schedules of work that are not too strenuous, (3) adequate food, (4) protection against communicable diseases, (5) facilities for recreation. These factors are then discussed in detail.

Much space is given to the consideration of food requirements. The fundamental facts which govern the selection of a suitable diet are clearly presented, enabling the nurse to eat wisely. Although the authors have classified strict vegetarianism as a fad, they do concede, with Macallum, that the vegetarian diet plus milk and eggs provides satisfactory nutrition.

Sound counsel is given in the chapter entitled, "Stimulants." Although the use of tobacco and alcohol is discouraged, the authors leave much to individual opinion. They admit that alcohol can justifiably have a place in one's life; that those who can use it in moderation may drink. Although this is admittedly a controversial question, it is the opinion of the reviewer that a book which purports to teach healthful living should not vacillate in giving the soundest possible advice.

Of special value is the section that deals with the prevention of disease; the most common communicable diseases are briefly discussed. These chapters are followed by highly useful instruction on the care of the eyes, ears, nose, throat and teeth. The feet also receive their due share of consideration. A book such as this on healthful living for nurses could not afford to omit a discussion of the sex question. This topic is dealt with frankly, sensibly and scientifically. The same typical candor and scientific attitude is also revealed in the chapter on "Modern Parenthood." The importance of mental health has not been overlooked. The nurse is encouraged to maintain a common sense attitude toward mental diseases and is urged to become intelligent in recognizing signs of maladjustment which might lead to more severe mental illnesses. Another chapter deals with later life, those years that follow the period of youthful exuberance. Sensible counsel is given on how to live after forty. Inasmuch as communicable diseases present a constant threat to the nurse's health, the appendix of the book includes a feature of great value, a section entitled, "The Control of Communicable Diseases," in which the common ones are described. At the end of each chapter the authors have included a list of "Discussion Suggestions" in the form of questions covering the material presented. Following these review questions is found a list of "References and Reading Suggestions" for additional collateral study.

This book is well written. A broad and comprehensive foundation has been laid for healthful living. Subsequent study and discovery on the part of the nurse will not be likely to render its statements obsolete, but serve only to germinate and unfold the many needs of truth here sown.

KINETIC BANDAGING. Including Splints and Protective Dressings. The Kinetic Method of Visual Teaching. By *Seymour W. Meyer*, B.S., M.S., M.D., Assistant in Surgical Anatomy, Long Island College of Medicine; Lecturer at Cumberland Hospital Training School, Brooklyn. Pp. 310, with 540 illustrations. Price, $3.50. Philadelphia: F. A. Davis Company, 1943.

The success of a textbook on bandaging is greatly enhanced by numerous clear illustrations. The 524 drawings and photographs in this volume are excellent because of sufficient simplicity and because each successive step is indicated numerically in the drawings, thus approaching the effectiveness of motion pictures. In addition to directions in the technic of bandaging there are several anatomical charts showing the underlying muscles and blood vessels which are a valuable addition. The basic principles of splinting are considered and brief instructions given in the use of plaster, wood and metal appliances for various portions of the extremities. This book is highly recommended as a text on bandaging and students should require a minimum of further personal direction while using this as a guide.

THE EDUCATION OF NURSES, Historical Foundations and Modern Trends. By *Isabel Maitland Stewart*, R.N., A.M., Professor of Nursing Education and Director of the Division of Nursing Education, Teachers College, Columbia University. Cloth. Pp. 399. Price, $3.50. New York: The Macmillan Company, 1944.

The subtitle of this new book accurately indicates its contents. The author has endeavored to trace briefly the history of nursing from pre-christian times to the year 1943 in order to show the historical foundations of modern nursing and nursing trends.

Though the book is intended primarily for students of nursing education, it should have a broad appeal. It is the hope of the author that it may provide orientation material for many non-nursing groups who are becoming interested in the nursing profession. "Such groups include board members and administrative officers in hospitals, nursing service agencies, higher educational institutions; members of state and other accrediting bodies; interested individuals in the allied professions of medicine, public health and education; parents and friends of student and graduate nurses; responsible government officials and public spirited citizens."

The style is concise and interesting. The author has chosen well the historical incidents to illustrate backgrounds of modern nursing. While only brief mention is given to pre-christian and early Christian foundations, much emphasis is given to the development of the Nightingale system both in England and later in America. The American system is compared and contrasted with the original Nightingale plan. Four periods of nursing in America are discussed.

The author points out that from 1873 to 1893 the Nightingale system was being established in America and schools of nursing were going through a pioneer period. Though the nurse was given added responsibility, she still spent far too much time and energy on scouring and scrubbing. Economic needs of the hospital largely molded the education of the nurse. The first American nurse published a textbook during this period, but planned instruction was very meager. By the close of the period, training schools for nurses were accepted by hospitals, physicians, and the public.

From 1893 to 1913, we are told that there was rapid growth in the number of training schools with an accompanying growth of problems. "During the decade 1890 to 1900 the increase in schools was from 35 to 432 schools (over 1200 per cent) and by 1909 the number had mounted to over 1,096 (a gain of 300 per cent)." During this period the course lengthened to three years, the three national nursing organizations were started, state legislation was introduced, the *American Journal of Nursing* was published and improvements were made in the preparation of nurse educators, with the beginnings of nursing education in universities.

The years 1913 to 1933 marked a period in which nurses endeavored to test and appraise nursing schools and nursing education as a whole. The first curriculum for schools of nursing was published just prior to World War I. Nursing like all other social institutions was upset by the war and its consequences. Important surveys were made in Canada and the United States which stimulated improvement in nursing education by pointing out basic defects.

The author states that the next ten years, 1933 to 1943, find professional nursing striving toward necessary readjustments. Curriculum revisions and accrediting of schools were undertaken. Collegiate schools rapidly increased in number. "More important than any of the individual accomplishments during this period were the evidences of increasing professional maturity. . . ."

In the later portion of the book, the problems of today's professional nursing, as it develops in a democratic society, are courageously discussed. "How far has modern nursing gone in realizing the hopes and plans of its leaders, and what are the prospects for continuous progress?" The author attempts to answer in part at least, the question she has raised. She concludes with a discussion of leadership as to kind and selection within the profession.

No one could be better prepared than the author of this book to deal with the subject she has chosen. For years she has ranked among the foremost nurses in America. She is known for her leadership not only in nursing education at Columbia University but also in connection with the major activities of the American Nurses' Association and the National League of Nursing Education during the past two decades. The nursing profession will welcome this outstanding addition to the Macmillan Nursing Education Monographs.

SYMPOSIUM ON WAR MEDICINE IN "THE HEBREW MEDICAL JOURNAL." The two semi-annual 1943 volumes of HAROFE HAIVARI (*The Hebrew Medical Journal*) edited by Moses Einhorn, M.D., are devoted to a symposium on war medicine. This is the sixteenth year of publication of the journal.

There are a number of valuable discussions in these volumes, among which are "The Treatment of Gunshot Wounds of the Head and Brain During the Present War," by *Leo M. Davidoff*, M.D.; "The Early Treatment of War Wounds With Emphasis on Prevention of Deformities," by *J. W. Maliniao*, M.D.; "Some Personal Observations on Military Surgery," by *Ed. K. Barsky*, M.D., "Newer Conceptions of the Treatment of Burns," by *Jesse Bullowa*, M.D., and *C. L. Fox, Jr.*, M.D., "The Status of Anesthesia in Military Surgery," by *S. D. Ehrlich*, M.D.; "Shock Syndrome and Its Treatment," by *S. Standard*, M.D.; "Ocular Injuries in Chemical Warfare," by *Ed. B. Gresser*, M.D., and "The Importance of the Proper Prosthesis in Post-War Rehabilitation," by *H. W. Wertheim*, M.D.

Of particular interest to the readers of the ARCHIVES is an article in Volume II by *William Bierman*, M.D. on "Physical Therapy in War Medi-

cine." After emphasizing the important part that physical medicine will play in the problems of post-war rehabilitation, Bierman mentions the scarcity of physical therapy technicians. He also stresses the need for a physician well versed in physical medicine in the surgeon general's office to direct the program of physical therapy in the armed forces. In summarizing the employment of physical measures in war medicine, he discusses their use in peripheral nerve injuries, fractures, amputation stumps, infected wounds, frost bite, carbuncles and abscesses, shock and psychoneuroses.

A section of Volume II is devoted to the translation by Leon Nemoy, M.D., of Yale University, of an old Hebrew medical manuscript dating back to the thirteenth century. It is the Arabic pharmacopoeia of Abu-Al-Mina Al-Kuhin Al-Attar. Although the major portion of it is devoted to the discussion of drugs, there are interesting bits of philosophy woven in which show that human nature has not changed through the centuries.

Considerable space is devoted to a section called "Palestine and War" in which are discussed the activities of the National Palestine Committee of Hadassah, the Red Mogan Dovid corresponding to the Red Cross of other countries, and Kupat Holim, the Workers' Sick Fund of the General Federation of Jewish Labor in Palestine.

Under the heading of "Personalia," *Solomon R. Kagan,* M.D., has contributed biographic sketches of Adolphus S. Solomons, Co-Founder of the American Red Cross, and Professor Max Neuburger, the great medical historian.

A little over half the journal is written in Hebrew, but the original articles are summarized in English.

The address of the editorial office is: *The Hebrew Medical Journal,* 983 Park Avenue, New York 28, New York.

A METHOD OF ANATOMY. DESCRIPTIVE AND DEDUCTIVE. By *J. C. Boileau Grant,* M.C., M.B., Ch.B., F.R.C.S. (Edin.) Professor of Anatomy, University of Toronto. Second edition. Cloth. Pp. 794. Price, $6.00, 651 illustrations. Baltimore: The William and Wilkins Company, 1944.

The distinctive feature of this textbook is its method of describing the parts of the body according to regions instead of the usual divisions such as osteology and myology. In this way the relation between bones and overlying soft parts is interpreted in reference to function. Such a method is particularly advantageous in considering the extremities, as the shapes of the bones and joints and position of muscular origins and insertions are pictures in a fashion that illustrate their purpose, locomotion. This study of anatomy is not merely the dissection of a dead body, but a description of living functioning organs. The acquisition of such knowledge accordingly becomes an interesting intellectual pursuit rather than an exercise in memorizing a list of facts. The text has the necessary clarity, but is written in a delightfully easy style which made the reading a pleasure for the reviewer. The abundant illustrations are line drawings based on dissected material, which by the elimination of excessive detail diagrammatically clarify intricate anatomical relationships very successfully. The more standard type of colored illustrations are not included in this book. They have been published in a separate two volume atlas. This textbook is highly recommended for medical students and should make a valuable addition to the reference library of surgeons and physical therapists.

A HANDBOOK OF ENGLISH. By *Charles W. Roberts,* University of Illinois; *Jesse W. Harris,* Southern Illinois Normal University, and *Walter G. Johnson,* University of Illinois. Cloth. Pp. 292. Price, $1.35. New York: Oxford University Press, 1944.

This book helps to make clear the basic principles of good composition. It answers most of the questions that arise in the mind of an intelligent adult when he tries to express himself correctly and effectively in straight forward prose. It gives innumerable examples of what is considered right and what is considered wrong in matters of usage. Most editors of medical journals would be glad if their contributors would read and use this book. It is recommended to the medical profession to help them to use the American English language.

CLINICAL AUDIOMETRY. By *Cordia C. Bunch,* M.A., Ph.D., formerly Associate Professor of Otology, Medical School, University of Iowa; Associate Professor of Research Otology, Johns Hopkins University; Professor of Applied Optics, Physics of Otology, School of Medicine, Washington University; Associate Director of Central Institute for the Deaf, St. Louis; Professor in Education of the Deaf, School of Speech, Northwestern University. Cloth. Pp. 178, with 74 illustrations. Price, $4.00. St. Louis: C. V. Mosby Co., 1943.

This book is written primarily for otologists and those interested in hearing aids. In the broader aspects, any mechanical appliance that rehabilitates human beings comes within the field of physical therapy. If it is a hearing aid, it may be classified as a physical therapeutic instrument. The late Doctor Bunch explains in an interesting and readable style the development of a modern audiometer, the technic of audiometric tests, and the difference between conductive and perceptive types of deafness. Directions are presented on the best way to use an audiometer, how and to what extent it can be employed in the fitting of a hearing aid. Anyone who is interested in hearing aids and the amelioration of hard-of-hearing will find this book valuable.

HEALTH INSTRUCTION YEARBOOK 1943. By *Oliver E. Byrd*, Ed.D., Associate Professor of Hygiene and Director, Division of Health Education, School of Health, Stanford University. Foreward by *Ray Lyman Wilbur*, M.D., Chancellor, Stanford University, Cloth. Price, $3.00. Pp. 308. Stanford University, California; Stanford University Press, and London: Humphrey Milford, Oxford University Press, 1943.

This Yearbook is the first in an intended annual series in the field of health education. Health has become an important part of education in American school and institutions of higher learning, and teachers of hygiene, school nurses and administrators need to keep abreast with current experience discovery and research in the fields of public health, medicine and allied sciences. The editor has had wide experience in teaching of hygiene and in training school health educators and has succeeded in presenting a large amount of pertinent and greatly varied material in a readable, generally well condensed and well captioned manner. The titles of the consecutive chapters in the volume are: Health as a Social Accomplishment, Health as a Social Problem, Nutrition and Health, Excretion and Health, Exercise and Body Mechanics, Fatigue and Rest, Mental Health and Disease, Heredity and Eugenics, Infection and Immunity, Chronic and Degenerative Disorders, Habit-Forming Substances, The Care of Special Organs, Safety, Health and the Physical Environment, Health Service and Facilities, Family Health, School Health, Occupational Health, Community Health Services, Trends and Probabilities. These chapters cover 300 abstracted articles and are followed by a bibliography, author index and subject index. The book makes stimulating reading and brings out many facts of vital interest to educators, physicians and intelligent laymen. The relation of public health as to the present war are especially well covered. The typography of the volume is excellent.

A. M. A. INTERNS' MANUAL. Issued under the direction and supervision of the Council on Medical Education and Hospitals and the Council on Pharmacy and Chemistry of the American Medical Association. Fabrikoid. Pp. 217. Price, $0.60. Chicago: American Medical Association, 1943.

In this new edition without materially increasing the convenient pocket size, still more valuable information has been collected for the use of young physicians. Revisions have been made to bring up to date the data on clinical laboratory practice, drug administration and materia medica. New additions include a section on diet and nutrition, a statement on the legal aspects of internships and a chapter on physical therapeutic measures prepared by the Council on Physical Therapy. The commonly employed physical agents are briefly, but adequately described and the more important indications for their use outlined. This manual should be particularly useful now that abbreviated internships are the rule and in hospitals not supplying printed copies of rules, procedures and prescriptions.

American Health Resorts

(*Continued from page 298*)

3. Ant, Herbert, and McClellan, Walter S.: Physical Equipment for Administration of Health Resort Treatment, J. A. M. A. **123**:695 (Nov. 13) 1943.

4. Reynolds, Charles R.: Importance of Health Resorts and Their Facilities in Medical Preparedness, J. A. M. A. **123**:832 (Nov. 27) 1943.

5. Elmore, Cyrus B., and McClellan, Walter S.: Administration, Supervision and Control of Health Resorts, J. A. M. A. **123**:898 (Dec. 4) 1943.

6. Baudisch, Oskar: Importance of Trace Elements in Biologic Activity, J. A. M. A. **123**:959 (Dec. 11) 1943.

7. Simons, A. M.: Economic Aspects of Health Resort Therapy, J. A. M. A. **124**:33 (Jan. 1) 1944.

8. Jarman, M. B.: Types of Treatments Administered at Health Resorts, J. A. M. A. **124**:231 (Jan. 22) 1944.

9. McClellan, Walter S., and Singer, Charles I.: Nature of Natural Therapeutic Agents Used at Health Resorts, J. A. M. A. **124**:426 (Feb. 12) 1944.

10. Singer, Charles I., and Phillips, Kenneth: Thalassotherapy, J. A. M. A. **124**: 1128 (April 15) 1944.

11. Report on Spas and Health Resorts. Committee Report, Arch. Phys. Therapy **20**:42 (Jan.) 1939.

12. The Utilization of Health Resorts for Military Reconstruction, Edit., J. A. M. A. **123**:564 (Oct. 30) 1943.

13. Drewyer, G. E., and Hughes, J. E.: A New Approach to the Problem of Incipient and Recurrent Malaria, Arch. Phys. Therapy **25**:273 (May) 1944.

PHYSICAL THERAPY ABSTRACTS

The Mechanism of Muscle Spasm in Poliomyelitis. Herman Kabat, and Miland E. Knapp.

J. Pediat. **24**:136 (Feb.) 1944.

One of the fundamental innovations of the Kenny concept of poliomyelitis is the emphasis placed on "muscle spasm." This is a condition characterized by shortening of the skeletal muscles which appears in the acute stage of the disease and may persist for months or years. It may be identified in the early stages by characteristic deformities, by prominence of tendons, by flatness and narrowing of muscle bellies, by increase or decrease in the number and depth of skin folds or creases, by limitation of range of passive joint motion and by other evidences of muscle shortening. The muscles in spasm are painful to stretch or pressure and may often be weak or even completely paralyzed. Spasm may be the direct cause or loss of function in opposing muscles because of the mechanical interference with motion produced by the shortened painful muscle. Relief of this condition may lead to increased active as well as passive motion and increased power in apparently paralyzed muscles by removal of this mechanical obstruction. Failure to relieve "spasm" by energetic and persistent therapy may result in permanent deformity as well as dysfunction of antagonistic and synergistic muscles.

Muscle spasm in poliomyelitis is of two types, hypertonus and hyperirritable stretch reflex. The clinical characteristics of muscle spasm are described. Muscle spasm is relaxed temporarily by spinal anesthesia or block of the myoneural junction in acute and subacute poliomyelitis. Intravenous pentothal decreases muscle spasm moderately in some patients and is ineffective in other patients.

Muscle spasm in poliomyelitis has a neurogenic mechanism and is apparently the result of an increased discharge of nerve impulses through the motor neurons.

Evidence is presented to support the theory that the pathologic basis of muscle spasm in poliomyelitis is a lesion of internuncial neurons in the gray matter of the spinal cord. The muscle spasm is produced as a result of release of proprioceptive reflexes from inhibition. Muscle spasm has been produced in the experimental animal by temporary arrest of circulation in the spinal cord. Correlated with this muscle spasm, the spinal cord showed a lesion localized to the internuncial neurons, while the anterior horn cells appeared normal. In 68 cases of poliomyelitis, review of the pathologic changes of the spinal cord revealed an internuncial lesion in almost every patient. Twenty-six patients showed an internuncial lesion with relatively normal anterior horn cells. Measurements of chronaxie of muscles in 14 patients with poliomyelitis who exhibited marked muscular spasm demonstrated that there is no correlation of muscular spasm with anterior horn cell damage. Many muscles in spasm showed a normal chronaxie while other muscles in spasm showed more or less marked increases in chronaxie. These results suggest that anterior horn cell destruction is not the basis of muscle spasm in poliomyelitis. Prostigmine, acting on the spinal cord to inhibit proprioceptive reflexes, relaxes muscular spasm and may be of therapeutic value in poliomyelitis.

The Treatment of Resistant Gonorrhea With Induced Hyperthermia Supplemented by Sulfonamide Therapy. John H. Harrison; Thomas W. Botsford, and Frederick P. Ross.

J. Urol. **51**:227 (Feb.) 1944.

Experiences with the combined fever and sulfonamide therapy of resistant gonorrhea in the 105th General Hospital over a period of ten months are described. Up to the date of this report this has proved to be the most effective available method of treating the sulfonamide resistant gonococcal infection. A description is given of the selection of patients, technic of administration of fever therapy, post-treatment management and tests for cure. The results have been excellent and 84 per cent cures (representing 252 patients) as determined by the criteria employed, have been obtained among the first 300 patients treated. Four hundred and twenty-six fever therapy treatments were given to this group of patients, and 1 death occurred as a result of combined hepatic and renal failure. No other serious complications were encountered, though there were 10 instances of transitory hepatitis that subsided completely within two weeks after treatment. There were only 10 patients who received one or more courses of treatment who were not improved.

Rehabilitation in Rheumatism. C. B. Heald.

Practitioner **907**:19 (Jan.) 1944.

Rehabilitation is perhaps the most dangerous word that has been introduced into medicine in the last hundred years. It has already become a slogan of politicians and there is a danger of it being exploited by job-seeking medical men. It may mean one thing to one group, whilst at the same time meaning something quite different to another.

The choice of physical treatment should be based on a true conception of the existing physical state that it is wished to alter. Here are some of the questions which arise in cases of rheumatism with one possible answer to each:

Is there effusion of lymph that needs removal?

Then use the direct current. Is there an insufficiency of ovarian hormone? Then use histamine ionization. Is there lack of blood supply? Then use short wave. Is there insufficiency of excretion by the skin? Then use brine or Wilde's baths to secure sweating with slightly raised temperature. Is there muscle atonia? Then use a faradic type of current. These are sufficient examples of this method of approach to the selection of physical treatments.

The dangers of the new word "rehabilitation" are further discussed and the necessity of realizing that it begins with the onset of the ailment and is not a new or isolated method of treatment, is emphasized.

The importance of recognizing that rheumatism, lumbago and similar terms used in rheumatology are not diagnoses and that good rehabilitation is impossible without a basic diagnosis, is insisted on. The physical, domestic, climatic, mental and occupational aspects of rehabilitation in relation to rheumatism are dealt with in principle.

Pes Planus. Frederic W. Ilfeld.

J. A. M. A. **124**:281 (Jan. 29) 1944.

No orthopedic aid can be effective without a proper fitting shoe. Length of the sole should allow a thumb's breadth from the great toe to the end of the shoe with full weight bearing, preferably tested with the soldier carrying a pack (50 to 70 pounds). Common aids in foot hygiene include the lacing of shoes loosely at the bottom, snug in the middle and loose at the top. This affords support to the longitudinal arch. Top holes do not need to be laced. Use of government issue foot powder, massage, manipulation, contrast baths, exercises, wearing two pairs of socks and cutting toenails straight across are helpful in relieving and preventing foot symptoms.

Painful Feet. Robert Bingham.

J. A. M. A. **124**:283 (Jan. 29) 1944.

The original and effective principle of treatment has been demonstrated by Dr. Morton to be the restoration of the weight bearing function and normal position of the first metatarsal segment of the foot. This is most simply done by placing a platform or support of the proper thickness under the sole of the foot beneath the distal head of the first metatarsal. The specific treatment compensates both for the shortness and for the relaxation of the first metatarsal segment, gives support to the medial side of the longitudinal arch and relieves the symptoms caused by excessive weight thrust on the second metatarsal and midtarsal region of the foot.

After the insoles are supplied to the patient they are checked for fitting and the proper height of the platform. Then they are worn for an hour or more daily, the time being increased until they are comfortable and the symptoms from the disorder have disappeared. The patient transfers them from one pair of shoes to another in changing footwear, never going without them again for more than a few hours.

General treatment is emphasized for the first week or so for the relief of acute symptoms and to strengthen the foot muscles whenever necessary. Exercises, contrast and whirlpool baths, and periods of rest and elevation of the feet are used. If the soldier is being treated as an outpatient, a period of seven to ten days on "light or fatigue and kitchen police duty" is often recommended to his company commander.

Of 100 soldiers treated by this method, 76 have been able to continue full military duty, "general service," while wearing the "compensating insoles."

A Case of March Fracture Occurring in Civilian Practice. Paul H. Harmon.

Guthrie Clinic Bull. **13**:71 (Jan.) 1944.

The occurrence of painful disorders in men in military service, including the incomplete fracture of the metatarsals which subsequently develops periosteal new bone demonstrable in the roentgenogram, has again assumed a popular place in the literature of the surgical diseases of bone. This condition (march fracture) was first described in numbers in World War I, chiefly in the German and French literature. Reviews of the history and clinical characteristics of this disorder have been published by Deutschlander, Jansen and by Meyerding and Pollock. Numerous reports are to be found in the literature, mostly since 1920. According to Meyerding and Pollock, the condition was first described by Breithaupt, a German military surgeon, in 1885, as a cause of swollen painful feet occurring in soldiers following forced marches. The absence of roentgenographic examination at that time led him to postulate that the condition was an inflammatory reaction in the soft tissues. It is noteworthy that the first case described in the English literature was in 1926 (Jansen). Recent reports have been published by Drummond, Stammers, Moore and Bracher, Krause, Sirbu and Palmer and by Sweet and Kissner.

A case of march fracture occurring in a young healthy male in a nonmilitary occupation is described. These cases emphasize the necessity of obtaining roentgenograms of every case of a painful disorder of the extremities.

The Production by Moderate Exercise of a High Incidence of Bends at Altitudes of 26,000 to 28,000 Feet. Cosmo G. Mackenzie, and Austin H. Riesen.

J. A. M. A. **124**:501 (Feb. 19) 1944.

It has generally been supposed that the bends and the chokes occur infrequently or not at all at altitudes under 30,000 feet. According to Armstrong, "With ascents at rates as high as 12,000 feet per minute up to 30,000 feet, symptoms are seldom noted even after prolonged stays at that altitude." The present report is concerned with

demonstrating that this need not be the case and that under appropriate conditions bends equaling in incidence and severity those reported at altitudes above 30,000 feet may be produced in the low pressure chamber at altitudes as low as 26,000 feet.

Moderate exercise and delayed denitrogenation in a flight of two hours' duration at 28,000 feet produced bends and chokes necessitating descent in 36 per cent of the cases. These symptoms occurred in 33 per cent of the men tested at 27,000 feet, in 21 per cent at 26,000 feet and in 0 per cent at 25,000 feet.

At 28,000 feet grade 3 bends was produced in 28 per cent of the men by moderate exercise alone. Delayed denitrogenation alone produced no grade 3 bends at this altitude.

In five bends producing flights (eighty-three man flights) at simulated altitudes of 26,000 to 28,000 feet for two hours the incidence of grade 3 bends was 29 per cent, of grade 2 bends 11 per cent and of skin sensations 17 per cent. Two cases of chokes, 1 accompanied by shock, occurred.

In 18 men making four or five bends producing flights the incidence of grade 3 bends or chokes ranged from 100 per cent in 3 men to none in 7. In 17 men the occurrence or absence of bends (grade 2 or 3) and chokes on their first two flights was a good index of susceptibility or resistance to these symptoms on subsequent flights.

These results suggest that bends and chokes may occur in men required to perform moderate exercise in combat ships at altitudes as low as 26,000 feet.

The Future of Spa Treatment. F. Clayton.

Practitioner **907**:33 (Jan.) 1944.

The value of physical medicine as practiced at the spas has been slowly and rather grudgingly appreciated by the medical profession of Great Britain, and favorable claims made by practitioners in this branch of medicine have often had a sceptical reception. It is right and proper that this traditionally British attitude should be sustained until convincing proof is forthcoming, but the present revival of interest both in medical and non-medical circles concerning rehabilitation with all its implications has given a great stimulus to physical departments everywhere, and what was previously regarded as ancillary has now become an essential integral service in every hospital. The clinical evidence of its worth accumulated from years of empiric usage is beginning to be reinforced by research and planned experiment, thus establishing an acceptable and scientific foundation for further development. Crude biological tests are being supplemented by accurate physical measurement, and health centers and spas throughout the country will in future take their full share in helping to raise the level of the nation's health by the preventive and curative means at their disposal.

From these general observations it will be seen that a distinct change of outlook is overtaking the spas of Britain. There plans are afoot for the maintenance and improvement of the nation's health. There will still remain as visitors to the spas those for whom palliative and retardatory treatment is alone applicable. Attention to early signs and symptoms will stem the flood of those misfortunes which now ravage the country and are considered chronic or incurable.

Rest at home, or in hospital, where etiologic factors can be investigated, will be enjoyed as a first step to treatment. Spas, with their natural advantages and the experience gained therein, should be able by enthusiasm and enterprise to render useful service as rehabilitation and health centers.

Treatment of Sciatica.

Correspondence, Brit. M. J. **4330**:32 (Jan. 1) 1944.

Dr. B. H. Shaw writes from Totnes: I was surprised to note in Sir Arthur Hurst's article on "The Treatment of Sciatiac" (Dec. 18) that no reference is made to local inductothermy, which I have found very successful even in cases of quite definite traumatic origin. I was under the impression that it was commonly prescribed where the apparatus was available.

Underwater Therapy at Spas. Euclid M. Smith, and Billie Louise Crook.

J. A. M. A. **124**:505 (Feb. 12) 1944.

While working with radioactive thermal waters in a therapeutic pool at a temperature of 98.6 F. over a period of years beginning about 1933 at Hot Springs, Ark., we found that the maintenance of the constant temperature of the pool resulted in an increase in the range of physiologic response in a manner most gratifying. We found that, if the exercises are administered during the time the body is immersed in water at a temperature of 98.6 F., a continuous hyperemia is maintained during the entire time the muscles are actively moving.

We found that underwater massage greatly enhances the value of the underwater treatment. If massage is given during the time the body is immersed in warm water, the continuous peripheral capillary dilatation and generalized interchange of blood from the deeper congested areas to the surface of the body render the massage much more effective in speeding the removal of waste products.

The type of underwater exercise given and the dosage depend on the condition of the individual patient, the type of disease, the duration of the disease, the acuteness of the disease, the age of the patient and many other factors. We believe that passive movement is useful in teaching the patient the possible range of his muscle action but that muscle training to be effective must be active.

We believe that properly staffed hydrotherapy departments adequately equipped with therapeutic pools, Hubbard-Currence tubs and whirlpools should be standard in every health resort in the United States which uses natural thermal waters in the treatment of disease.

Heat in the Treament of Shock. Andrew W. Kay.

Brit. M. J. **4331**:40 (Jan.) 1944.

The application of heat has become fully established as a cardinal principle in the treatment of traumatic shock. It has been believed to exert a favorable influence, mainly by relieving the cutaneous vasoconstriction and thus augmenting the venous return. The possibility that the cutaneous vasoconstriction is a compensatory mechanism and that heat may be harmful has only recently been entertained.

Fifteen normal subjects were exposed for one hour to the hot-air cradle. Intravenous saline was administered to 10 of these and intravenous plasma to 5.

A progressive rise in pulse rate and venous pressure, together with a progressive fall in arterial blood pressure, was observed in all cases. Symptoms resulted, including nausea, vomiting, dehydration, headache, perspiration, muscular pains and exhaustion. In certain cases these were severe.

These findings would appear to contraindicate the prolonged use of heat in the treatment of patients suffering from traumatic shock.

Treatment of Facial Palsy.

Correspondence, Brit. M. J. **4332**:92 (Jan. 15) 1944.

Sir:—In his letter to the Journal of Dec. 25, Dr. Wilfred Harris has taken the statement, "The test for faradic excitability does not provide any useful information in forming a prognosis," apart from the context and has expressed his disagreement. The statement is not given as the opinion of the annotator but is the conclusion reached by Dr. Karsten Kettel from his investigation of the late results in 264 cases of facial palsy, and it is therefore fair to give his reason for reaching this conclusion. He says:

"In half my cases the paralysis was partial and the faradic test presumably positive, even if in a greatly lowered degree. Since the final result in half the cases of partial paralysis—that is, one-fourth of the total number in this group—was nevertheless bad, it is obvious that the faradic test cannot be a reliable indicator. It is possible that a completely negative test may provide a hint. The fact that the faradic excitability is only reduced does not permit any prognostic conclusion."

On the other hand, the long experience of so distinguished a neurologist as Dr. Wilfred Harris is conclusive. It seems, however, that Dr. Harris refers to cases of Bell's palsy without middle-ear disease, whereas the cases followed up by Dr. Kettel were all secondary either to middle-ear disease or to operative treatment for its relief, and consequently were cases with a greater or less degree of pathological change in the temporal bone as well as in the nerve itself. This may perhaps explain the discrepancy between the observations of Dr. Harris and of Dr. Kettel, and it would no doubt be of interest to your readers to know if this explanation commends itself to Dr. Harris.

Physics and the Surgeon.

Correspondence, Brit, M. J. **4332**:92 (Jan. 15) 1944.

Sir:—I read with great interest the Bradshaw Lecture by Mr. H. S. Souttar (Dec. 11, p. 737), on physics and the surgeon. He states: "The radiation of which I am speaking consists of ether waves transmitting energy across space." I think it only fair to point out that there may perhaps not be an ether of space but just space (or space-time of relativity). With the advent of Einstein's relativity, it has often been said that ether has been abolished. Ether merely is a convenient noun to describe the properties of space. It is often a convenient grammatical construction to have. If we persist in using the term ether, it should be understood as the subject of the verb "to undulate," and acts as this subject fairly well. The term ether as understood by the old physicists is no longer believed by modern scientists.

Some Uses for Dry Cold Therapy, and a Proposed Cooling Cabinet. W. G. Bigelow, and E. C. G. Lanyon.

Brit. M. J. **4336**:217 (Feb. 12) 1944.

The therapeutic use of cold has lately been attracting the attention of investigators in many different fields. Recent studies point to the possibility of its much wider employment as a form of treatment in the future. In amputations for diabetic gangrene Allen (1941) and Bancroft, et al. (1942) have shown the value of refrigeration as an anesthetic and demonstrated how it appears to eliminate surgical shock from such a procedure. Its use in retarding the growth and relieving the symptoms of certain malignant tumors was investigated a few years ago by Temple Fay. Several other uses for dry cooling and actual freezing are being studied at the present time.

A description is given of a refrigerating device to investigate the dry cold treatment of frostbite, traumatic arterial spasm, peripheral embolism, and certain wounds of the extremities. Observations made on a working model have proved it capable of providing the conditions necessary for such treatment. The apparatus is simple, portable and flexible in operation, and has been designed primarily to meet the requirements of an army in the field.

Frostbite, Immersion Foot and Allied Conditions.

Army M. Bull. **65**:136 (Jan.) 1943.

The global extent of the present conflict necessitates the employment of United States troops in large numbers in arctic regions and sub-zero temperatures. The problems involved in the prevention and treatment of frostbite therefore now assume new and greater importance.

The military importance of frostbite rests on three principal factors: (1) geographical distribution of the war strategy; (2) the equipment pro-

vided for the individual soldier with which to combat cold and moisture (this is the responsibility of the commanding officer and the Quartermaster Corps); and (3) the education of the troops in the technic of self-protection against cold (this is the responsibility of the commanding officer, the medical personnel and all junior and noncommissioned officers).

Examination for Diploma in Physical Medicine.

Lancet **1**:232 (Feb. 12) 1944.

These regulations, copies of which may be obtained post free provide that: (a) the examination is open to practitioners of not less than three years standing, who have held recognized hospital appointments, and have completed a course of full-time special study extending over twelve months; (b) the whole examination which is divided into two parts must be taken in the first instance, and subsequent admission to Part II is, of course, dependent on success in Part I. A syllabus indicating the scope of the examination is published in the regulations. Since there may be candidates whose experience, either in one of the Services or in the EMS, during the last three or four years, may justify their admission to the examination under regulation 6, arrangements are being made to conduct the examination for the first time in July next.

The Principles of Treatment in Peripheral Nerve Injuries. Max T. Schnitker.

Bull. U. S. Army M. Dept. **73**:61 (Feb.) 1944.

Bullet and shrapnel wounds of peripheral nerves are common injuries among war casualties. Many different types of repair of peripheral nerve injuries were carried out in the last war, but no standard test of recovery of function was applied and few cases were followed long enough to justify conclusions. At least three to five years should elapse after repair of an injured nerve, with a careful analysis of the electrical activity and muscle group function on a standard basis, in order that results can be compared. Possibly when this war is over, our organization will have been so planned that such a study can be completed. That kind of program has just been put into effect.

The aims of physical therapy are to improve the circulation to the involved parts by massage and galvanic exercise; to diminish muscle wasting and fibrosis by massage; and to maintain mobility of joints by passive and active exercises. The problem of the type and amount of electrical stimulation to be used to enhance nerve regeneration after repair is still much in debate. Suffice to say, the general opinion now is that there is a definite beneficial effect to the nutrition of the limb and to its readiness to become useful once the voluntary power has returned. From the psychologic point of view its value is profound since the time required for such specialized tissue as nerve to heal requires the greatest patience on the part of both the physician and the patient.

Homeostatic Adjustments After Exercise. 1. Acid-Base Equilibrium of the Blood. Nathan W. Shock.

J. Gen. Physiol. **27**:154 (Jan. 20) 1944.

Previous studies have shown that after severe exercise the pH and bicarbonate contents of the blood diminish. The present report presents data on (a) the extent and nature of changes in acid-base balance of the blood which occur after work and (b) the rate at which the acid-base balance returns to normal after maximal displacement. Simultaneous measurements of oxygen consumption, blood pressure, and pulse rate were made in order to assess the physiologic changes induced by the exercise.

The rate at which displacement and recovery of the acid-base equilibrium of the blood occur in young adult males subject to short periods of maximal exertion has been determined.

Displacement of acid-base equilibrium produced by severe exercise is along the fixed acid path, similar to the path of displacement produced by ingestion of acidifying agents such as ammonium chloride.

Maximum displacement of the acid-base equilibrium is not reached until 7 to 10 minutes after the cessation of exercise. By this time over 50 per cent of the displacement in oxygen consumption, respiratory volume and blood pressure has disappeared. A much greater metabolic acidosis was produced by exercise than could be induced by the oral administration of ammonium chloride. Recovery from the metabolic acidosis produced by exercise was much more rapid (10 times) than was recovery from the acidosis produced by ammonium chloride. After exercise the pH, returned to normal values more rapidly than did the bicarbonate content of the serum.

The Pathology of Arthritis. Samuel A. Goldberg.

Am. J. Clin. Path. **14**:22 (Jan.) 1944.

The study of the pathology of arthritis dates back to antiquity. The evolution of the theories of the changes that take place in the affected joints parallels the trends of thought regarding the disease processes in general. Our modern knowledge of the pathology of arthritis was accelerated by the monumental work of Nicholls and Richardson. They conclude that deforming arthritis may be divided into two groups, namely the proliferative and the degenerative.

Very early changes of rheumatoid and degenerative arthritis were described. They are probably two distinct disease entities, etiologically and morphologically. Rheumatoid arthritis may show evidence of activity for a long time, particularly where ankylosis does not occur. Some of the changes described as being present in degenerative arthritis such as synovial vili, subchondral cysts and islands of cartilage, possibly represent an inactive phase of rheumatoid arthritis. The earliest changes in the articular cartilage appears to be altered pH to the alkaline side as evidenced by a change in the staining reaction.